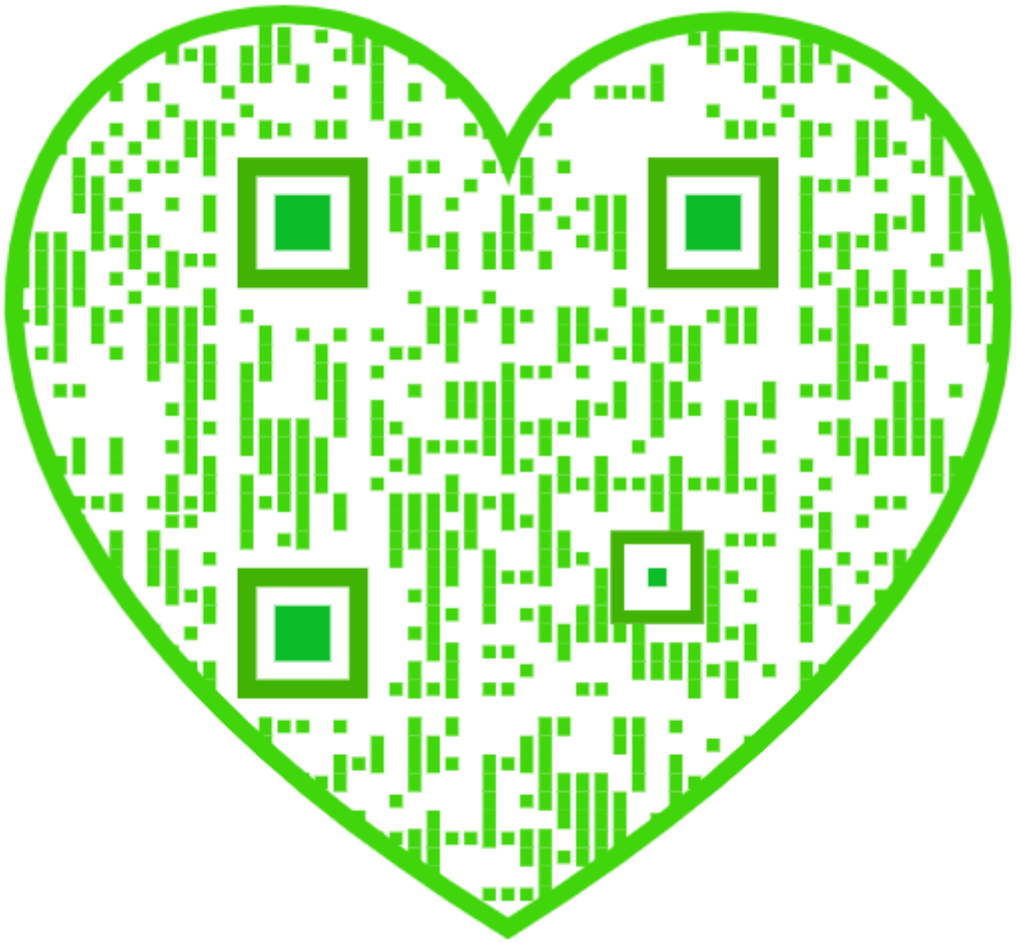

POMEROY'S

MINING MANUAL

FOR

PROSPECTORS, MINERS AND SCHOOLS;

SHOWING

WHERE AND HOW TO SEARCH FOR GOLD
AND SILVER MINES, AND
TO MAKE TESTS.

EDITED BY
HENRY R. POMEROY.

THIRD EDITION.
RE-ARRANGED, REVISED AND ENLARGED.

ST. LOUIS.
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PREFACE.

Mining interests in this country have long attracted considerable attention, and, at the present day, instead of showing any signs of abating, the interest manifested is greater than ever before.

Men of every age, character and social condition hurry to the mining districts in search of fortunes, sanguine of success, but wholly unprovided with the means of attaining it; without any knowledge of mining enterprise; without any guide or assistance from the experience of others—trusting only in their own judgment, which is in these matters entirely uneducated and practically worthless, or in luck, as much a superstitious fancy in this business as in any other.

Any business, to be successful, requires special knowledge and skill, and this is peculiarly true of mining, since it is based upon a correct understanding of several of the most difficult of the sciences.

Fortunes have been wasted in the senseless search for mineral veins in places where they could not by any possibility exist, and many valuable mines have brought nothing to their discoverers because they did not know how to make good use of their property after they had found it.

A thorough knowledge of geology, mineralogy, metallurgy and chemistry would require a long course of study; but as very much of these is not important to the prospector or miner, it is proposed in this small volume to bring together in a convenient shape so much of them as is directly valuable to him, that he may have an opportunity of learning to recognize the metalliferous rocks, the precious ores and their simple tests and assays, as well as their

differences from deceptive and worthless minerals, and the proper methods of proceeding in prospecting for mineral veins or deposits.

Without such knowledge it is as impossible to succeed, as for a lawyer who has no knowledge of law, or the physician who is ignorant of medicine. Many ignorant men who enter the mining districts pretend to despise science—forgetting that science is the recorded experience of those who have worked most earnestly and most successfully. It is a very common experience that these self-sufficient men, after wasting their time in the search for ore in impossible places, and exhausting all their money in utterly useless undertakings, return home on foot sad and dejected, bitterly denouncing the country and the mines, while they alone are to blame.

If this volume shall prove to be of assistance to the prospector and investor, it will have accomplished the purpose of the author. Should the reader desire to push his study further in this direction, he will find the following books to be authoritative:

Geology.	. Dana's.
"	. Buckland's.
"	. Lyell's.
"	. Hillside's.
"	. Geike's.
Mineralogy.	. Dana's.
"	. Comstock's.
Metallurgy.	. Overman's.
"	. McDowall's
Chemistry.	. Muspratt's.
"	. Miller's.
Chemical Analysis	. Fresenius'.
Assay Schemes.	. Rickett's.

In this book great pains have been taken to avoid the use of scientific terms as far as was possible, as it was thought best to present the subject in the form most useful for practical use.

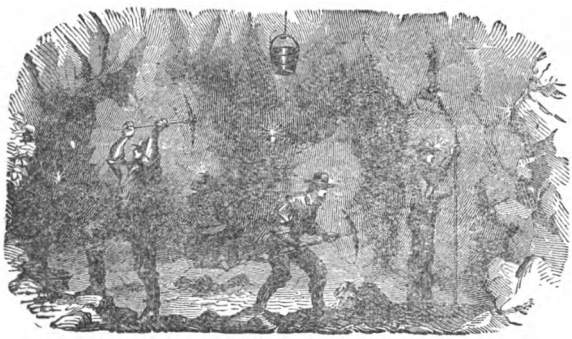
No attempt has been made to teach accurate assaying for the simple reason that no man can well be both an assayer and a prospector, and this book is written for the latter.

Since, however, it often happens that a prospector, or any individual, desires to learn whether an ore carries any metal, and

whether there is much or little probably present, a number of blowpipe, chemical and special tests have been described, which will be found useful. In case the reader desires to learn assaying, he should make up his mind to devote his time and attention to it alone, provide himself with good books and good apparatus, and remember that accuracy and success will result only from patient and careful application.

HENRY R. POMEROY.

St. Louis, Mo.



MINERALOGY.

Under this head it is proposed to present a brief, classified description of the minerals found most abundantly in the rocks, also of the most important metallic ores and other minerals ordinarily met with in prospecting and mining.

In the examinations of a mineral it is specially necessary to notice accurately its *lustre*, *color*, *streak*, *hardness*, *tenacity*, *crystal form*, *cleavage*, *specific gravity*, and any other peculiarites which will enable us to recognize it another time, or to distinguish it from similar minerals.

The *chemical composition* of a mineral is important, but as the prospector will at first probably have no means of determining this for himself, he will learn to recognize the minerals by their other properties, and to find its constituent elements by reference to the book.

The LUSTRE of a mineral may conveniently be described as being *metallic*, like the polished surface of a metal, *vitreous* or *glassy*, *waxy*, *resinous*, *or dull*.

COLOR is exceedingly various even in the same mineral, but nearly all minerals have some one or few prevalent colors, these will be given.

STREAK is the mark made by rubbing or scratching the mineral over a hard white substance, such as unglazed china or stoneware, the rough edge of a broken plate, a piece of white rock, or any substance of light color which is harder than the mineral to be tested. In case no such substance is handy, powder a little of the mineral with a hammer, and rub it with a knife blade on a white piece of paper. The streak shows the color of the powdered mineral which is often characteristic and very different from the color of the mineral. Thus iron pyrites has a brass-yellow color and a black streak, while copper pyrites scarcely to be distinguished from it in appearance has a greenish streak.

HARDNESS is the ability of a mineral to scratch other substances, and is determined by this means. The hardest substance known is the diamond, and it is therefore called ten or the highest in the scale. It will be easy to collect from the rocks a scale of hardness sufficient for all practical use.

Thus *Talc* may be taken as the first of the scale, and its hardness is called 1. The others easily secured are as follows:

Gypsum 2. Calcite 3. Fluor Spar 4. Feldspar 6. Quartz 7. Topaz 8. Corundum 9. Diamond 10.

Substances harder than quartz are not commonly met with. If any of the foregoing substances are not easily obtained others of similar degree of hardness may be substituted for them—thus *roll sulphur* (brim-

stone) may be used instead of *gypsum* as its hardness is 2, or *zinc blende* 4, a common mineral in gold and silver districts, may be used instead of *fluor spar*, etc. If a mineral is to be tested for its hardness, try to scratch it with the one which you think hard enough, if the mineral is softer it will be scratched, and you try the next softer mineral of the scale, until the hardness of the mineral you are testing is easily ascertained to lie between certain numbers of the scale. Thus, if the substance is scratched by *fluor spar* (or *blende*) but not by *calcite* its hardness is between three and four; if the *fluor spar* scratches it easily it is nearer three, if but little it is nearer four. In testing for hardness it is far better to use minerals than to trust to the fingernail, knife blade, glass, or file, though after some practice with minerals, these may be used with success.

In selecting the minerals of the scale be sure to take the crystals of the substances given (except, of course, *roll sulphur* if that is used instead of *gypsum*); small pieces are as good as larger ones. A whole scale might be carried in a vest pocket. *Gypsum*, *calcite* and *fluor spar* will be found of greatest use. The pieces should not be carried loosely together as the harder ones would destroy the others; wrap them separately in paper.

TENACITY may be *brittle* as when the mineral is readily splintered or broken in any direction, *sectile* easily split in one or several directions, but not splin-

tering, or *malleable*, not breaking, but flattening under a blow from a hammer.

CRYSTALLINE FORM will be given only in cases where it is plainly marked. A complete description of crystal systems would in most cases be unnecessary, and in a volume of this size would occupy too much space. It will be sufficient to characterize such crystals as approach in form the *cubical*, having the angles, right angles and the faces square or rectangular as pyrites and galena; *hexagonal* having six angles and faces on the sides as quartz, and generally terminated by a pyramid on one end; *rhomboidal* having the faces inclined at angles greater or less than right angles, but in other respects resembling the cubical system as calcite and feldspar; and *tabular* arranged in layers or plates like mica, often showing an indefinite degree of *cleavage*.

CLEAVAGE is the tendency of crystal to split in certain definite directions, but not in others. Sometimes a crystal has a perfect cleavage in one, two or three directions, generally parallel to the surfaces of the crystal, good examples of cleavage will be found in *fluor spar*, *calcite*, *galena*, *feldspar*, etc. If instead of spliting in planes only a splinter is struck off leaving a concave depression, such a fracture is called *conchoidal*, if the splinter is irregular the fracture is called *splintery;* flint or anthracite coal furnish examples of the former, quartz crystals of the latter.

SPECIFIC GRAVITY is the weight of a substance com-

pared with water, and is an important point to notice. To ascertain this accurately it is necessary to have a pair of balances and a set of accurate weights. The rule to follow is as follows. Suspend the mineral by a fine thread or hair and weigh it in the air, and afterwards immerse it in a glass of water and weigh it again; it will weigh less when immersed in water than when in the air. The difference between these two weights will be its loss of weight in water and will be exactly equal to the water displaced. To find the specific gravity of the mineral divide its weight in air by its loss of weight in water. Thus, for example, a piece of quartz which weighs 4 ounces in air will weigh about 2 1/2 ounces in water; its loss of weight will be 1 1/2 ounces. Dividing 4 ounces by this gives 2 2/3 (or nearly 2.7); thus quartz is found to weigh 2 2/3 times as much as water. Since it is not generally possible to be provided with scales and weights, it will be found convenient to learn to judge of the specific gravity of minerals by comparing them with substances that are known: thus for example water is one and objects lighter than it will float, heavier ones will sink; quartz may be taken as 2.5; iron pyrites 5; cast iron 8; lead 11; gold about 18.

The CHEMICAL COMPOSITION of minerals can not be very fully treated here. Very few of the minerals are *simple* or *elementary*. Gold and platinum, however, are generally found *native* or not in chemical combination with other elements, but in small grains me-

chanically diffused among other rocks. Silver, mercury, copper and sulphur are sometimes found native, but like other minerals they are generally in combination with some other element.

The chemical name of any compound is formed from the names of the elements which compose it; if there are only two of these elements the name of the compound terminates in *ide*, as silver sulphide a compound of silver and sulphur, lead chloride a compound of lead and chlorine. Since it is more common to hear the names of these compounds given in the reverse order they will be so presented in this book, and the above mentioned substances will be called sulphide of silver, chloride of lead, etc.

If in addition to two other elements, oxygen enters into the compound, the name given it will terminate in *ate* or *ite*, generally the former; thus in the above compound the chemical union of oxygen with silver and sulphur would produce a sulphate of silver, a very different substance from the sulphide. Some substances unite with the oxgen of the air, and spontaneously undergo great changes as for example some forms of iron pyrites (sulphide of iron) unite with oxygen on exposure, and are converted to sulphate of iron (copperas or green vitriol).

In the following table for convenience of reference the minerals given will be classified into *rock constituents* and *metallic ores*. Under the head of ores will be classed those minerals which either sometimes carry

the precious metals or are associated with them or may be mistaken for them.

In the examination of minerals and the comparison with the following table, notice first the lustre and size of the crystals. The minerals of the rocks form either large or small crystals, but the crystals of the ores are usually small and often present the appearance of being fine grains disseminated through the gangue-rock. In examining a mineral chemically or otherwise separate it as much as possible from the associated rock, and if the particles are fine place them on a piece of white paper. A good magnifying glass will be found of great assistance. In judging of the specific gravity or hardness of a mineral it is necessary that it should be separated completely from adhering particles of different rock.

While there are certain exceptions to the rule, it may be generally stated that large crystals which are hard, relatively light, and possessed of glassy (or vitreous) lustre, are minerals of the rocks, whereas if they are small, granular, or spray like, dark in color, soft and heavy, they should be tested for metal as there is a strong probability of their containing it. It frequently happens too that in many valuable ores, the metallic compounds are so finely disseminated that they appear only as a stain upon the gangue-rock, this is particularly true with the sulphide and chloride of silver. It must also be borne in mind that even the same kind of crystals are rarely of the same constitution, but contain varying per cents of other minerals.

ROCK CONSTITUENTS.

MINERAL	COMMON NAME	LUSTRE	COLOR	HARDNESS
1. QUARTZ	Quartz	vitreous	transparent	7
	Amethyst	"	clear, purple	
	Rose quartz	"	clear, pink	
	Smoky quartz	"	smoky	
	Chalcedony	waxy	white to brown	
	Carnelian	"	red	
	Agate	"	banded or clouded	
	Flint	"	dull	
	Touchstone	dull	velvet black	
	Jasper	"	yellowish brown	
2. ORTHOCLASE	Potash Feldspar	vitreous	white red gray green	6
3. ALBITE	Soda Feldspar	vitreous	white or red	6
4. LABRADORITE	Lime-soda Feldspar	vitreous	white, gray	6
5. OLIGOCLASE	Soda-lime Feldspar	vitreous	white, green	6.5
6. OBSIDIAN	Volcanic Spar	vitreous	green brown black	6.7

ROCK CONSTITUENTS.

SP. GR.	CLEAVAGE	COMPOSITION	REMARKS
	imperfect		crystals hexagonal massive it is white.
	"		crystals hexagonal.
	"		" "
	"		" "
2.7	conchoidal fracture	oxide of silicon, with traces of impurities, chiefly iron.	massive and not crystalline
	"		"
	"		"
	"		translucent at the edges only.
	"		used for testing alloys.
	"		
2.5	distinct	silicate of alumina and potash	
2.6	perfect	silicate of alumina and soda	
2.7	perfect	silicate of alumina and lime	
2.6	perfect	silicate of alumina, lime and soda	
2.7	conchoidal fracture	fused feldspar	found in volcanic rocks.

ROCK CONSTITUENTS.

MINERAL	COMMON NAME	LUSTRE	COLOR	HARDNESS
7. MUSCOVITE	Mica	pearly	yellowish white to dark olive	2.5
8. BIOTITE	Black mica	pearly	black, brown	2.5
9. GARNET		vitreous	all colors generally red	7
10. TOURMALINE		vitreous	all colors, often black	7
11. TOPAZ		vitreous	generally yellow	8
12. BERYL		vitreous	green	7.5
13. HORNBLENDE AMPHIBOLE		vitreous	black green to velvet black	5.5
14. CHRYSOLITE		vitreous	green	6.5
15. TALC	Chinese tallow, soap stone	greasy	white, light green	1
16. SERPENTINE		dull	dark green	3.5
17. CHLORITE		vitreous	green to blue	2.5

ROCK CONSTITUENTS.

SP. GR.	CLEAVAGE	COMPOSITION	REMARKS
2.9	in plates	silicate of alumina	plates elastic.
2.9	in plates	silicate of alumina magnesia and iron	
3.5	obscure	silicate of alumina and lime	occurs in gneiss and other rocks in small 12 sided crystals.
3.–	none	silicate of alumina and soda	occurs in long slender hexagonal crystals.
3.5	distinct	silicate and fluoride of alumina	
2.7	distinct	silicate of alumina and glucina	
3.1	distinct	silicate of magnesia and lime	fuses to a dark glass before the blow-pipe
3.3	conchoidal	silicate of magnesia and iron	gelatinizes with hydrochloric acid.
2.7	perfect	silicate of magnesia with some water	plates of crystals brittle and non-elastic.
2.6	splintery	silicate of magnesia	usually found massive and clouded in color.
2.7	perfect	silicate of magnesia and alumina	found granular in granite and other rocks.

ROCK CONSTITUENTS.

MINERAL	COMMON NAME	LUSTRE	COLOR	HARDNESS
18. ANTHRACITE	Stone coal	sub-metallic	black	2.5
19. GRAPHITE	Plumbago, Black lead	metallic	black, gray	less than 1
20. CALCITE	Calc spar	vitreous	all colors; generally white	3
21. DOLOMITE	Magnesian lime	vitreous or pearly	white, yellow, pink,	4
22. GYPSUM SELENITE	Plaster stone	vitreous	white to brown	2
23. BARYTE	Heavy spar	vitreous	white, yellow, red, etc.	3
24. FLUORITE	Fluor spar	vitreous	clear, green, yellow	4

ROCK CONSTITUENTS

SP. GR.	CLEAVAGE	COMPOSITION	REMARKS
3.5	conchoidal	carbon with impurities	burns leaving ash.
	sectile	carbon nearly pure	greasy feel, soils the fingers, found in seams in older rocks.
2.6	perfect	carbonate of lime	effervesces easily with acids
2.8	perfect	carbonate of lime and magnesia	does not effervesce easily.
2.3	perfect	sulphate of lime	burned, produces plaster of paris.
4.5	distinct	sulphate of barium	generally associated with galena.
3.1	perfect	fluoride of calcium	ground fine and mixed with sulphuric acid etches glass.

MINERAL ORES.

MINERAL NAME	COMMON NAME	LUSTRE	COLOR	STREAK
1. GOLD	Gold	metallic	gold yellow	gold yellow
2. ELECTRUM	Alloy	metallic	yellowish white	yellowish white
3. TELLURIUM	Tellurium	metallic	tin white	tin white
4. SILVER	Silver	metallic	silver white	silver white
5. AMALGAM	Amalgam	metallic	gray	gray
6. MERCURY	Quick silver	metallic	tin white	
7. SYLVANITE	Graphic tellurium	metallic	steel gray, white to brassy yellow	gray
8. PETZITE	Gold tellurium	metallic	iron black	dark gray
9. HESSITE	Telluric silver	metallic	lead gray	gray
10. ARGENTITE	Silver glance	metallic	gray black	gray black
11. ACANTHITE	Silver glance	metallic	iron black	gray black
12. CINNABAR	Cinnabar	submetallic	cochineal red	scarlet
13. CHALCOCITE	Copper glance	metallic	steel gray	gray
14. GALENITE	Galena	metallic	lead gray	gray black
15. SPHALERITE	Blende	resinous	yellow, brown and black	yellow and brown
16. PYRITE	Pyrites	metallic	brass yellow	black
17. MARCASITE	White pyrites	metallic	pale yellow	gray black

MINERAL ORES.

COMPOSITION	HARDNESS	TENACITY	SP. GR.	REMARKS
gold with a little silver	2.5	malleable	16-19	nearly always native.
gold and silver	2.5	malleable	12-16	from 20 to 50 per cent silver.
tellurium silver and gold	2.5	brittle or sectile	6.2	burns with a blue flame edged with green, thick white fumes and strong odor
silver and a little gold	3.	malleable	10.5	heated alone does not tarnish, with a little sulphur turns black
silver and mercury	3.	brittle	10. 5-14	when rubbed on bright copper gives a silvery lustre
mercury	liquid	liquid	14.	same as amalgam.
gold, silver and tellurium	1.75	sectile	5.7-8	shows tellurium flame at high heat.
silver, tellurium and gold	2.5	brittle	8.75	tellurium driven off at high heat leaving a globule of silver which then answers to test above given for silver.
silver tellurium	2.5	sectile	8.5	
sulphide of silver	2.5	malleable	7.2	crystallizes in cubes, sprays and threads. Silver 87 per cent when pure.
sulphide of silver	2.5	maleable	7,2	crystals rhomboidal. 87 per cent silver when pure.
sulphide of mercury	2.2	sectile	9.-	found as a scarlet earthy mass. If pure wholly volatile. Occurs in slate rocks and shales.
sulphide of copper	2.75	sectile to brittle	5.7	generally tarnished blue and green, carries silver.
sulphide of lead	2.75	sectile	7.5	cleavage in cubical crystals, always carries some silver.
sulphide of zinc	4.	brittle	4.	cleavage perfect, translucent if light colored.
sulphide of iron	6.5	brittle	4.5	strikes fire with steel, sometimes carries gold in gold regions—also in some localities silver.
sulphide of iron	6.	brittle	4.7	crystals not cubical generally radiate, flattened, etc.

MINERAL ORES.

MINERAL NAME	COMMON NAME	LUSTRE	COLOR	STREAK
18. STROMEYERITE		metallic	steel gray	gray and shining
19. STERNBERGITE		metallic	bronze yellow and brown	black
20. STEPHANITE	Brittle silver	metallic	iron black	iron black
21. PYRARGYRITE	Ruby silver	metallic	black red	cochineal red
22. MIARGYRITE		metallic	iron black	dark cherry red
23. PROUSTITE	Ruby silver	vitreous	cochineal red	scarlet
24. BORNITE		metallic	red brown	greenish black
25. CHALCOPYRITE	Copper pyrites	metallic	brass yellow	greenish black
26. TETRAHEDRITE (FREIBURGITE)	Gray copper	metallic	steel gray & iron black	gray, black and red
27. POLYBASITE		metallic	iron black	black
28. FREISELEBENITE	Gray silver ore	metallic	light gray	gray
29. DYSCRASITE	Antimonial silver	metallic	silver white	gray
30. NAUMANNITE		metallic	iron black	gray black
31. EUCAIRITE		metallic	light gray	shining

MINERAL ORES.

COMPOSITION	HARDNESS	TENACITY	SP. GR.	REMARKS
sulphide of silver and copper	2.5	sectile to malleable	6.2	silver 53 per cent soluble in nitric acid.
sulphide of silver and iron	1.5	malleable	4.2	silver 33 per cent, violet blue tarnish.
sulphide of silver and antimony	2.75	sectile	6.2	silver 68 per cent.
sulphide of silver and antimony	2.3	sectile to brittle	5.8	silver 60 per cent.
sulphide of silver and antimony	3.	sectile	5.2	silver 36 per cent.
sulphide of silver and arsenic	2.75	sectile	5.4	silver 65 per cent, crystals rhomboidal also granular.
sulphide of copper and iron	3.5	brittle	5.	generally carries silver.
sulphide of copper and iron	4.	sectile to brittle	4.2	often carries silver.
sulphide of copper and antimony	4.	brittle	5.	2 to 30 per cent of silver, when carrying silver is of a light gray color.
sulphide of silver copper and arsenic	2.5	sectile, brittle	6.2	65 to 70 per cent silver, thin flakes, cherry red by transmitted light.
sulphide of silver lead and antimony	2.2	rather brittle	6.2	silver 23 per cent.
antimonide of silver	3.5	sectile	9.5	silver 78 per cent.
selenide of silver and lead	2.75	sectile to malleable	8.	silver 20 to 70 per cent, cubic, melts easily before blowpipe.
selenide of silver and copper	soft	malleable		rare, in films—staining calcite.

MINERAL ORES.

	MINERAL NAME.	COMMON NAME.	LUSTRE.	COLOR.	STREAK.
32.	CERARGYRITE	Horn silver	resinous	gray, green & blue	shining
33.	BROMYRITE.		waxy	green & yellow	yellow
34.	IODYRITE.		waxy	yellow to brown	yellow
35.	EMBOLITE.		waxy	greenish to yellowish	greenish
36.	CALOMEL.	Horn quick silver	adamantine	gray	white
37.	CASSITERITE.	Tin stone, Stream & wood tin	vitreous	brown, black or gray	white or brown
38.	SMITHSONITE.		vitreous to pearly	white, green or brown	uncolored
39.	CALAMINE.	Galmei	vitreous	whitish, bluish, greenish & brownish	uncolored
40.	WILLEMITE.	Troostite		white, green, red, yellow & brown	uncolored
41.	ZINCITE.	Red zinc ore	brilliant	bright red	orange yellow
42.	MILLERITE.	Capillary pyrites.		brass to bronze yellow	bright
43.	LEUCOPYRITE.	White pyrites	metallic	tin white	black
44.	ARSENOPYRITE.	Mispickel	shining	silver white	grayish black
45.	ORPIMENT.	Yellow arsenic	pearly	fine yellow	yellow
46.	MOLYBDENITE.		metallic	lead gray	gray or green
47.	TETRADYMITE.		metallic	pale steel gray	steel gray
48.	ARSENIC.	Native arsenic	metallic	tin white to gray	tin white
49.	STIBNITE.	Gray antimony	metallic	lead gray	lead gray

MINERAL ORES.

COMPOSITION.	HARDNESS	TENACITY.	S P. G R.	REMARKS.
chloride of silver	1.5	malleable	5.4	silver 75 per cent., cuts easily, melts readily and is soluble in ammonia.
bromide of silver	1.5	sectile	5.8	associated with horn silver and rarely found seperately.
iodide of silver	1.5	malleable	5.5	
chloride and bromide of silver	1.3	malleable	5.2	
chloride of mercury	1.5	sectile	6.5	moistened with ammonia or soda it blackens.
oxide of tin	6.5	brittle	6.9	on charcoal with soda it is reduced to metallic tin.
carbonate of zinc	5.	brittle	4.4	it effervesces with acids.
hydrous zinc silicate	4.5	brittle	3.9	heated in sulphuric acid it dissolves and on cooling it gelatinizes.
silicate of zinc	5.5	brittle	4.	gelatinizes with hydrochloric acid.
oxide of zinc	4.5	brittle	5.5	thin scales deep yellow by transmitted leight.
sulphide of nickel	3.5	brittle	5.5	wool like in cavities of magnesia lime at St. Louis.
arsenide of iron	5.	brittle	6.8	heated gives white fumes and odor of arsenic.
arsenide of iron	5.5	brittle	6.4	heated crumbles, turns yellow or brown and emits a garlic odor.
sulphide of arsenic	2.	sectice	3.5	burns with blue flame on charcoal
sulphide of molybdenum	1.5	malleable	4.5	before blowpipe colors flame yellowish green.
telluride of bismuth	2.	sectile	7.5	lminae flexible and soils paper.
native metal	3.5	brittle	5.7	massive, columnar and granular.
sulphide of antimony	2.5	brittle	4.5	rhomboidal crystals, melts in candle flame.

MINERAL ORES.

MINERAL NAME.	COMMON NAME.	LUSTRE.	COLOR.	STREAK.
50. AZURITE.	Blue malachite	vitreous	deep blue	bluish
51. MALACHITE	Green malachite	vitreous	emerald green	pale green
52. CUPRITE	Red copper ore	sub metallic and earthy	deep red	brownish red
53. CHRYSOCOLLA		shining and earthy	bright and bluish green	
54. PYRRHOTITE	Magnetic pyrites	metallic	bronze yellow to copper red	dark gray
55. CHLOANTHITE	Cobalt glance	metallic	tin white or gray	gray
56. NICCOLITE	Copper nickel	metallic	pale copper red	pale brownish red
57. GERSDORFFITE	Nickel glance	metallic	silver white or gray	gray black
58. LINNÆITE			pale steel gray	blackish gray
59. ANGLESITE		adamantine resinous or vitreous	white, gray or green	blackish
60. CROCOITE	Crocoisite	vitreous	bright red	orange yellow
61. PYROMORPHITE		resinous	green, brown and yellow	white
62. CERUSSITE *	Lead carbonates	vitreous	white, gray, yellow & brown	white

* The Leadville discoveries have attracted attention to the carbonates of lead. The silver bearing carbonates are not easily described, being unusually without crystalline form. They are often associated with galena, and not unfrequently a mass of carbonate, when broken will be found to contain a central core of galena. The *hard carbonate* is a mineral, the iron and lead of which are but slightly oxydized and carbonized and is generally of a brown color and hard. The *soft carbonate* is usually sand, impregnated with minerals being thoroughly carbonized and oxydized and generally rich in silver and of yellow color.

Limonite (iron stone) or indurated yellow clay, are often taken by the 'tenderfoot' for the silver-bearing carbonates.

When the carbonate of lead is pure by dropping nitric acid upon it, it will effervesce, but if iron is largely present the test will fail. By the use of the blow-pipe (on charcoal) a button of lead containing silver may be obtained from the carbonate of lead.

By fusing in a small crucible some of the powdered ore with carbonate of potash, mixed with a little clear charcoal dust, a button of lead containing silver will be obtained.

MINERAL ORES.

COMPOSITION.	HARDNESS	TENACITY.	SP. GR.	REMARKS.
blue carbonate of copper	3.5 to 4.5	brittle	3.8	when abundant is valuable.
green carbonate of copper	3.5	brittle	3.8	blackens if heated.
oxide of copper	3.5	brittle	3.8	tenorite, is black oxide of copper.
hydrous copper silicate	2.4	brittle	2.4	with soda on charcoal it yields a globule of copper.
sulphide of iron	4.	brittle	4.5	when powdered, is attracted by a magnet.
arsenide of cobalt, nickel and iron	5.5	brittle	7.	contains nickel from 1 to 35 per cent.
arsenide of nickel	5.5	brittle	7.	contains 40 to 45 per cent. of nickel.
arsenide and sulphide of nickel and iron	5.5	brittle	6.	contains 20 to 40 per cent. of nickel.
sulphide of cobalt and nickel	5.5	sectile	5.	it tarnishes to copper red.
sulphate of lead	3.	brittle	6.	it fuses in flame of a candle.
chromate of lead	3.	brittle	6.	it is the chrome yellow paint.
phosphate of lead	6.5	brittle	6.5	it resembles light beryl.
carbonate of lead	3.5	brittle	6 4	when heated, it crumbles and turns yellow or brown.

A glance at the foregoing tables will show many contrasts between the minerals of ordinary rocks and the ores. The latter as a rule have metallic lustre, high specific gravities, and low degrees of hardness; while the first have glassy or earthy lustre, low specific gravities and high degrees of hardness.

They differ also generally in the nature of their chemical composition, and for this reason it is often useful to test a mineral for the presence of sulphur, arsenic, etc., as this is very easily done. Simply roasting a fragment of the mineral on a strip of tin is often sufficient to show the presence of sulphur, arsenic, selenium, tellurium or antimony—which when present are a good indication of silver, lead or copper, though not of course conclusive.

It is, however, better to be provided with an alcohol lamp and a few pieces of hard glass tubing about one-fourth inch in diameter and cut in lengths of about four inches. (Cut the tubing by marking with a file and breaking across). Place a little of the powdered ore near one end of the tube and heat it in the lamp flame. Hold the tube so that the end holding the ore is a little lower than the other. Notice if the mineral gives off any fumes or odor.

The odor of a burning match indicates sulphur, that of garlic indicates arsenic, that of decaying horseradish, selenium. Antimony gives off a pungent odor somewhat like arsenic.

Notice if there is any formation of a coating in the

upper or cooler portions of the tube. Such a coating is called a *sublimate* and would be formed by

ARSENIC; *white*, easily driven out of the tube by heating. Under a glass shows brilliant pyramid shaped crystals. Volatilizes without melting.

ANTIMONY; *white*, not easily driven like arsenic, fuses to pale yellow globules before volatilizing.

SELENIUM; *white*, under a glass shows four sided needle-shaped crystals.

TELLURIUM; *white*, if heated forms colorless drops first, and then evaporates.

* BISMUTH; *orange yellow* while hot, *lemon yellow* while cold.

MERCURY; *gray*, under a glass shows fine metallic globules which form in larger ones if rubbed with a clean copper wire, and form on it a silvery coat.

Tests made by means of the blow pipe are quite as characteristic, and since a blow pipe and candle form a very simple and satisfactory means of making a test, a knowledge of their proper use will be found exceedingly valuable. While it is not possible to form an exact estimate of the value of an ore by this means, it is easy to detect the nature of the metal, and to form some idea of its quantity, and this may be done quickly and with certainty. Use a blow-pipe with a con-

* This substance is a good indicator of silver though it may not be in combination directly with that metal.

carbon. For brevity R. F. will signify *reducing flame*, and O. F., *oxidizing flame*.

In handling the blow pipe a little practice will be necessary before a perfect control of it is acquired. You should be able to breathe regularly through the nose, at the same time that you blow steadily through the pipe. This is done by distending the cheeks and admitting the air into the mouth a little at a time as it may be needed, without disturbing the respiration. The object aimed at is a steady blast that does not flicker, and may be easily maintained for five or ten minutes or longer if necessary. A little practice will enable you to do this.

Place the ore (always finely powdered) in a slight cavity cut in the charcoal with the knife point, and if you are heating it in the O. F. do not let the R. F. reach it; in the R. F. keep it there steadily. Use in each test about as much powdered ore as can be picked up on the point of a small knife blade.

Heat the substance in the O. F.

NOTICE.

1ST. The odor if there is any, (these have been described above).

2D. The crust upon the charcoal, a little away from the ore. (The charcoal should have no ash upon it).

3D. The effect upon the ore itself.

I. The incrustation is *white* forming at some dis-

tance from the specimen, easily dissipated when the the flame is driven against it, emitting a garlic odor —ARSENIC.

II. *White* forming nearer the specimen, driven by the flame from one part of the charcoal to another— ANTIMONY.

III. *Yellow* while hot, *white* when cold, forming near the specimen, volatilized with difficulty—ZINC.

IV. *Pale yellow* when hot, *white* when cold, forming close up against the specimen, in strong R. F. forming bright malleable metallic globules— TIN

V. *Lemon yellow* when hot, *sulphur yellow* when cold, tinges the flame blue, readily yielding a button in R. F.—LEAD.

VI. *Dark orange yellow* when hot, *lemon yellow* when cold, forms brittle globules in R. F.—BISMUTH.

VII. *Dark red*,—SILVER. If antimony and lead are present the color is *crimson*. (Silver may be present though no coat be formed).

If the specimen itself changes color, is *dark* when hot, *red* or *brown* when cold—IRON.

If it remains *white* and infusible QUARTZ, LIME, etc.—

If it is *yellow* when hot, *white* when cold; a small particle heated strongly is volatilized—ZINC.

It is *pale yellow* when hot, white when cold; a particle heated strongly is not volatilized—TIN.

If the specimen fuses to a metallic globule and colors the flame green—COPPER.

If it fuses to a metallic globule, but does not color the flame — GOLD or SILVER. Flatten with a hammer on smooth iron and notice the color.

If no distinct result is shown by the above, add to a fresh specimen of the ore about an equal amount of carbonate of soda [baking or washing soda previously roasted] and heat for a long time in the R. F. *quartz* is dissolved to a glass, *gold*, *silver*, *lead*, *copper or zinc*, if present are reduced to a metallic globule. Now heat in the O. F., *lead*, *zinc or tin*, if present are changed to the characteristic incrustations above described: *gold*, *silver or copper* remain metallic, and may be examined separately.

With a few chemicals it is possible to extend the number of tests, but these are not conveniently carried about. The following will be found among the most useful and easily secured:

Nitric Acid; Muriatic Acid; Ammonia; Ferrous Sulphate (Copperas); Oxalic Acid.

A few *test tubes* and *beaker glasses* would be found useful though the latter may be dispensed with.

Roast a little of the ore thoroughly in the O. F. with soda and transfer to a test tube when cold, fill the tube one-fourth full with dilute nitric acid (four parts water to one of acid) and warm over an alcohol lamp (or by sticking it down half way in a cup of warm sand standing on the stove or in the fire); the

appearance of brown, suffocating acid fumes indicates that a metal is being dissolved. When completed fill the tube with water which should be clear and pure and let it settle, pour one-third of it into another test tube and add *a few drops* of muriatic acid.

A WHITE PRECIPITATION indicates *silver, lead, mercury* or possibly *antimony or bismuth.* Add muriatic acid drop by drop until no more precipitate seems to be formed, then add six or eight drops more and shake it rapidly, by this means the *bismuth or antimony* if present will be redissolved, and the precipitate will contain only *lead, mercury or silver.* Let it settle. Pour off as much of the water as you can, fill it again with fresh water, let it settle a second time, and pour off all the water you can. Add a little ammonia, and shake the precipitate; if it turns black, MERCURY; if it remains white, LEAD, if it dissolves SILVER.

In case the precipitate does not dissolve shake it repeatedly. After some time pour the clear liquid into another test tube—boil off the ammonia gas (not violently) add nitric acid—white precipitate—SILVER. The object of this last test is to detect a small quantity of silver in the midst of a larger quantity of lead or mercury.

If the original solution was of a blue green color it indicates COPPER, an apple green NICKEL. To test for copper insert a clean bright strip of iron, [the knife blade]. It will soon become coated with metallic copper. Metallic copper will likewise precipitate

silver and mercury, the first as a loose white coat, the second as a gray film showing the mercury lustre on rubbing with the fingers.

To examine an ore for gold it is necessary to proceed more carefully than with silver. The following will be found effective:

Pulverize finely a quantity of the ore in a mortar. Concentrate this by washing the lighter dust off until a half teaspoonful or so remains. Roast this with soda as before. Place it in a test tube, and fill this one-fourth full of aqua regia (a mixture of one part nitric acid to four parts of muriatic acid). Put the test-tube in a cup or can of water (it will float) and boil for an hour or longer; if acid fumes escapes put a little water from time to time in the test-tube. Fill the tube with water and allow to settle, pour off one-third of it into another tube and add a clear solution of *copperas*.

A dark precipitate settling only after a long time—appearing ruby red on looking through it; indicates GOLD.

To a second part of the original solution add a solution of *oxalic acid*—dark green or greenish black precipitate indicates GOLD.

To a third part add a little *ammonia*; a yellow precipitate indicates GOLD.

In case it is desired to test both for silver and gold, test for silver (mercury and lead) first by dissolving the ore

in nitric acid and use the undissolved residue in testing for gold.

If a silver button is obtained with the blow-pipe and it is desired to ascertain whether it contains any gold put it in a white saucer and pour on it a few drops of nitric acid, if a gray or black film covers the bottom gold is present, if it remains pure and white there is none or but very little.

SPECIAL TESTS.

I. GOLD. Grind the ore fine and wash a quantity in a saucer, pouring off the lighter mud until it is reduced to a small bulk, add more ore and repeat. The gold may be made to appear.

Add a little mercury to this residue rubbing it with the fingers; pour it into an *iron* spoon and heat; the mercury is volatilized, and gold if there is any appears. Metallic silver and copper would also be collected by this means.

To make sure of the presence of gold add a little lead to the metal left in the spoon, after the mercury is driven off and melt them together. Dissolve this button in nitric acid. Gold if present is left undissolved as a gray button or powder which shows the gold color on rubbing with a knife blade.

II. SILVER. Roast the powdered ore dry with one-third the quantity of salt in a crucible or in a clay

pipe bowl, when cool add a little water and heat again slightly, stir this with a clean copper wire. It will become coated with silver if any be present. A clean bright strip of iron or zinc will be blackened.

(2). Treat a little of the ore with hot, dilute nitric acid in a test tube (or stoneware cup or saucer).

Let it cool and settle; pour the clear liquid into another tube or cup, add a clear solution of common salt [a few drops will be sufficient]. If there is a white precipitation expose this to the sunlight. If it darkens it contains silver, if not it is probably lead, possibly mercury. Pour off the liquid and add a little ammonia to the precipitate. If it is dissolved, it is silver; if blackened, it is mercury; if unaffected, it is lead.

This test will not detect the presence of silver where it exists in the powder of the chloride or bromide. In such cases the first method is preferable. The following however is suitable for all ores:

(3). Powder the ore and concentrate it by washing the lighter mineral away, place a portion [a teaspoonful] in a stoneware cup with a small piece of zinc and cover with water, add a little sulphuric acid [oil of vitriol, about one-tenth the amount of water used] and let it stand for half an hour. If at that time all the zinc is dissolved add more zinc and wait ten minutes after all effervescence ceases, then pour off all the water you can, being careful to loose none of the solid substance. Fill the cup with water, let it

settle completely and pour it off again. Repeat this several times then take out the piece of zinc, scrape what adheres to it, put back into the cup and add dilute nitric acid; proceed as in the second test. This method is tedious but it is very satisfactory.

III. COPPER. Heat the ore in vinegar, take it out, and expose to the air; if it gradually becomes coated green or blue, copper is present. Place a little of this green (or blue) substance before the blow-pipe, it should color the flame green. Moisten with a drop of muriatic acid it will color the flame azure.

Some ores of copper will not answer to the above test. In such cases roast the finely powdered ore at red heat for some time on a piece of tin or in an iron spoon. When cooled treat in a stoneware cup or saucer with dilute nitric acid (or hot strong vinegar] the solution formed should be green or blue. Place a few drops before the blow-pipe and notice the flame tests as above.

Moisten a little of the ore with muriatic acid and a few drops of nitric acid, heat it for a few moments add a little water and stir with a piece of bright iron wire; It will be coated with copper.

Add a little water to the above solution (3), and when it has settled clear pour some of it into a glass and add ammonia drop by drop; a pale blue precipitate will be formed which dissolves as ammonia is added and forms a deep blue solution. Iron is generally present in copper ores and will be precipitated

by the ammonia as a brown flaky mass, which often time settles and the blue solution of the copper may be seen above it.

IV. MERCURY. (1). Heat the finely powdered ore in an open glass tube as described previously—the mercury will form a gray sublimate in the cooler parts of the tube.

(2). Treat the ore with dilute nitric acid, and pour the clear liquid into another vessel off of the undissolved earth, add to this muriatic acid. If a white precipitate is formed pour off all the water possible, and add a little ammonia. If the precipitate is blackened; mercury is present.

(3). Make a *retort* of a clay pipe in the following manner: Fill the pipe bowl three-fourths or four-fifths full of a mixture of equal parts powdered ore and iron filings, and finish filling it with a stiff paste made of equal parts iron filings and sulphur to which has been added a little salt and water, when dry heat cautiously until all moisture has been expelled, then invert so that the bowl hangs down and letting the end of the stem dip into a glass of water about an inch below the surface, heat the bowl as strongly as possible with a lamp or blow-pipe flame or by any other convenient means which will secure a red heat. The mercury will distil over and gather in a liquid globule in the bottom of the glass of water. The clay pipe should have a long stem with a large bore.

V. NICKEL AND TIN. These metals are generally

found associated with other metals or elements in the ore as for example: iron, copper, bismuth and antimony or possibly lead and zinc. To distinguish them in the presence of the other substances with the few chemicals made use of in these tests requires care. The following scheme if accurately followed will prove efficient:

Powder the ore very finely and dissolve 1/4 to one 1/2 teaspoonful in a stoneware cup, with a mixture of one part nitric and four parts muriatic acids.

Do not measure the acids in a metal spoon or vessel but use in quantity what would amount to one or two teaspoonfuls of the mixture, and add about the same quantity of water. Place the cup containing the mixture in a small pan or can of cool water and stand it on the stove. By this means it may be heated to boiling without danger of breaking the cup. After fifteen or twenty minutes fill the cup 1/3 full of water and let it stand until it settles clear, or what is better filter it through a cone of blotting paper. Pour the clear solution into another cup, glass or wide-mouthed bottle, and place in it a strip of clean zinc. Copper, antimony, bismuth, tin and nickel will separate from the solution and form a coat on the zinc or dark spongy flakes floating in the liquid. When you think all action has ceased test the liquid with another piece of bright zinc (made bright by scraping or filing), and notice if it is colored or coated—if it is, more time must be given it or perhaps more zinc must be added,

if the zinc used in testing the solution remains bright even after some moments, test again with bright iron (the knife blade) and notice if there is any stain of copper upon it. When neither of these tests show the presence of a metal in the solution [although some nickel may still remain dissolved] pour it off, carefully from the precipitate into another glass [or clear bottle] and add ammonia. If nickel or copper is present the solution will turn blue, if copper, however, has been thoroughly removed by the zinc so that it is not deposited on polished iron, even after some moments the blue color is due to nickel.

The metallic precipitate (obtained by the zinc) contains all the copper, tin, lead, bismuth and antimony and most of the nickel that existed in the ore. Wash this precipitate carefully by filling the cup with clear water and pouring it off again several times, being sure to save all the precipitate, waiting each time till it settles perfectly. Drain it as well as you conveniently can, and put half of it into another cup or glass. To one of these halves add a little nitric acid and heat if necessary until all dark flakes are dissolved. All of the metals mentioned except tin will be dissolved; tin if present will remain as a white insoluble sediment. If the experiment has been carefully performed, the solutions always perfectly cleared, (the color of the solution if clear is immaterial,) etc, the appearance of this insoluble white powder may be taken as a proof of the presence of tin.

To make sure of the presence of nickel add to the other half of the metallic precipitate a little water and about $\frac{1}{3}$ as much muriatic acid and heat for ten or fifteen minutes. By this means the nickel along with some other metals is dissolved, but copper and antimony are not. After cooling pour the clear solution into a clean glass or cup, (the liquid will have a green color if nickel be present) and add ammonia. A clear blue color indicates nickel.

Copper would also give this blue color with ammonia, but by this process it is prevented from getting into the solution.

It will be found very convenient to have a dozen test tubes to use instead of the cups and glasses mentioned in the foregoing tests.

Hints as to Handling Apparatus.

In case glasses or bottles are used they should be of clear white glass and not green, blue or brown. Do not use a metal spoon or vessel of any kind in connection with the acids. Stone-china and glass are however insoluble in them and may always be used.

In pouring a solution off from a precipitate or sediment, always place the rim of the glass or cup against the edge of a strip of glass or against a glass rod and pour the liquid drown the strip or rod, this prevents its running back under the cup and allows you to pour it more quietly without disturbing the sediment.

Always reduce the ore to be dissolved to a very fine powder; it is best to sift it through a piece of linen or cotton cloth.

Give the ore time to dissolve. As long as effervescence goes on or acid fumes escape in the cold, solution is progressing. Some ores require several hours for perfect solution.

Ores generally carry impurities (gangue, etc.), which are insoluble in acids—these consist usually of silica, clayey material, mica, baryte or possibly fluor spar. No attention, however, is paid to this in the tests given.

Keep the chemicals pure. Never put the corks in the wrong bottles. Use glass stoppered bottles for your acids, and for ammonia.

Get in the habit of testing with small amounts of ore and acids, the work is just as certain, more speedy and far less wasteful; for that reason test tubes will be found to be very useful.

DESCRIPTIVE GEOLOGY.

The earth is a globe, whose interior is believed to be liquid. The reasons for this belief are various; among the most important are the existence of volcanoes and earthquakes, the eruption of igneous rocks through rocks not igneous, and particularly the fact

that the temperature rises as we desend below the surface so rapidly that at a comparitively little distance the most refactory substances would be melted.

The thickness of the earth's solid crust is variously estimated at from ten to fifty miles, though from the nature of the case this is a matter only of speculation.

Of the sixty-four chemical elements now known; the crust is composed chiefly of about sixteen: oxygen, hydrogen, carbon, chlorine, silicon, sulphur, fluorine and phosphorus, called non-metals, and aluminum, iron, magnesium, calcium, potassium, sodium, barium and manganese, known as metals.

These elements in their various combinations form the different minerals, of which the rocks are composed and which have been more fully treated under the head of mineralogy.

The most abundant element is oxygen, after this silicon, aluminum and calcium; iron is the great coloring material, nearly all the red, yellow and brown hues in the rocks being due to the presence of this element.

The rarer elements are generally the most valuable, among others may be mentioned zinc, lead, tin, copper, nickel, silver, platinum and gold; of these gold and platinum are generally found native (in the metallic state); silver and copper sometimes so, though generally in combination with other elements; and nickel, tin, lead and zinc always in such combination (see mineralogy).

A rock is a mass of mineral whether hard or soft. In geology a bed of sand or gravel or soil is strictly speaking a rock.

Rocks have been formed chiefly in two distinct ways: first, by being solidified from the melted state in cooling; second, by being spread out by action of water in layers or *strata*.

The primary rocks have been formed in the former manner; they are unstratified and crystalline in structure. Of such rocks granite is the most common.

The *secondary* rocks were formed of the fragments or grains of the primary rocks worn off by the action of water, air and other natural forces, and spread out by the water. Such rocks are often called *fragmental* and *sedimentary* and often contain *fossils* of marine animals or plants. Sandstones and clay rocks are the most common of these fragmental rocks.

Limestone is, strictly speaking, generally not a fragmental rock. Since it is made from the shells of marine animals and plants, but the manner of its formation is similar since the shells are partly pulverized and are levelled by the water.

The *stratified* rocks were originally soft and yielding like our present beds of sand and clay, but were afterwards compacted and hardened by time and the pressure of other deposits forming on top of them.

Though originally formed under the sea, these stratified rocks are now found at all elevations above its level, this is due to the fact that part of the earths

crust has been thrown into great folds and elevated into mountains, while other parts have sunk to form the ocean basins.

For the same reason it also follows that the strata are now seldom found in their original level condition, but are tilted at all angles even to the perpendicular.

The stratified rocks have also frequently been subjected to great heat and pressure, and have been changed in character to crystalline rocks. Such rocks are called *metamorphic*. It is sometimes very difficult to distinguish between the primary igneous rocks and the metamorphic sedimentary rocks; the latter, however, generally show that they have been stratified. Metamorphic granite, gneiss and mica schist are examples of metamorphosed sandstones; slate is a metamorphosed clay rock; statuary marble a metamorphosed limestone.

Strata are said to be *conformable* when they lie regularly one on the other, and are parallel to each other, when strata have been formed across the upturned edges of other strata, and thus are not parallel with them they are said to be *unconformable*.

It is evident that the strata first formed were laid upon primary or unstratified rocks, and that among the strata themselves the first formed are the lowest and oldest, and the last formed are nearest the surface, and youngest or latest. Since, however, rocks were not made evenly in the same manner all over the world, it follows that the surface rock of one region may

be a very old formation, while that of another may be very late.

It also happens that in some regions the stratified rocks are very thick, sometimes 40,000 feet or more, while in other regions there is none at all to be found, the primary rock the unstratified granite being the surface rock, and so far as can be ascertained the only rock to unknown depths below the surface.

PROF. BUCKLAND in the year 1836 classified the formations as primary, transition, secondary, tertiary, deluvium and alluvium.

PROF. MANTELL in the year 1844 classified the formations as metamorphic rocks (or mica slate series) fossiliferous strata, (or secondary formation), tertiary system and drift.

PROF. ANSTED in the year 1844 classified the formations as metamorphic rocks, older palæozoic, middle palæozoic, newer palæozoic, old secondary, middle secondary, newer secondary and tertiary period.

PROF. LYELL a very eminent geologist, of Edinburg, Scotland, in the year 1852 classified the formations as metamorphic rocks, primary fossiliferous, secondary, tertiary and post tertiary.

PROF. H. D. ROGERS in the year 1858 introduced the following system of classification for the United States, viz.: Primary, the appalachian palæozoic day, (consisting of the lower, middle and upper palæozoic), mesozoic period, cainozoic period, drift and alluvium.

Opposite is presented a tabular view of the different formations as agreed upon by geologists of the prestime in the order of the time of formations.

TIMES.	PERIODS.	FORMATIONS.	PREVAILING ROCKS.
SURFACE	QUATERNARY	SURFACE	SOIL
CENOZOIC. OR RECENT.	POST TERTIARY.	DRIFT.	shell beds, clay, sand and gravel.
	TERTIARY.	DRIFT. STRATIFIED.	sand, clay, loose sandstones and marls.
MESOZOIC.	CRETACEOUS.	STRATIFIED.	beds of sand, marl, loose and compact limestone, clay, etc.
	JURASSIC.	STRATIFIED.	marl, gypsiferous lime and sandstones.
	TRIASSIC.	STRATIFIED.	soft coal, gypsiferous red sandstones and marls.
PALÆOZOIC.	PERMIAN.	STRATIFIED.	limestones.
	CARBONIFEROUS.	STRATIFIED.	coal and sandstones.
	SUB-CARBONIFEROUS.	STRATIFIED.	limestones and sandstones.
	DEVONIAN.	STRATIFIED.	limestones, slates and sandstones.
	UPPER SILURIAN.	STRATIFIED AND METAMORPHIC.	slates, shales, marble and granitoid rocks.
	LOWER SILURIAN.	STRATIFIED AND METAMORPHIC.	compact limestones, marble and granitoid rocks.
ARCHÆAN.	METAMORPHIC. UNSTRATIFIED.	METAMORPHIC. UNSTRATIFIED.	granitic rocks.

It will be noticed from the foregoing table, that the metamorphic rocks are among the earliest formations and are thus among the lowest.

Owing to the folding of the earth's crust (due perhaps to the shrinking of the globe in cooling) the strata have in mountain regions been raised to great heights. The tops of the folds having been *denuded* or worn off by the *eroding* action of water and ice, the lower formations are freely exposed and laid bare over large areas or perhaps subsequently covered with soil. The material thus worn off has gone to form the beds of gravel, sand and soil in the valley lands.

The present valleys have been formed by the action of water, and do not often take the same direction as the original rock folds, but may and do cut these folds irregularly into ridges or hills. The edges of the strata, therefore, frequently project at various angles from the hill sides instead of sloping in the same direction as the general surface. Such a projection of a stratum above the surface is called an *outcrop*.

The *dip* of a stratum is its slope or incline, and is the angle it makes with the plane of the horizon. The direction and amount of the dip should both be given in order to ascertain its nature, e. g., a stratum dips N. 20° E. at an angle of 23°.

The *strike* is indicated by the horizontal line drawn on the surface of the stratum, and is always at a right angle to the dip. The strike is easily found by placing

the edge of a carpenter's level on the surface of the stratum and moving it about until it is level, the edge of the level shows the strike.

These terms *outcrop*, *dip and strike*, are used also with the same signification in describing mineral veins.

In regions where rocks have been much folded they have also been frequently broken and dislocated. When such a break or *fault* occurs it generally happens that the strata on one side of the fault have slipped up or down many feet, sometimes many thousand feet, and a late formation may thus be brought to a level with one older by many ages of time.

In case the formations are exposed as along the sides of gulches or canons, it is often easy to trace the successive strata until we find the continuation of the one which was terminated at the fault. On this principle a coal bed is sometimes found miles away from the fault at which it was lost.

The rocks are not only faulted, but (especially the older and more brittle crystalline rocks), are cracked in various directions. These cracks are called *veins or fissures*, and since their formation and filling is of especial importance, they will be described more fully further on. When the fissure has been very large and a great amount of melted rock has poured up from the liquid interior of the earth, filling the opening and often overflowing or interpenetrating the other rocks, such a formation is called a *dike*. These

dikes are sometimes very extensive,many miles in width and length. The rock which is found in these dikes is a kind of lava; porphyry, trap, trachyte, basalt, etc. Some of them are of comparitively late formation as they are found to penetrate from the interior through the unstratified and stratified rocks and overflowing those which were formed at a late period.

It is evident that when a dike is formed the heat of the great mass of lava will have the effect of cracking the surrounding rocks. Many fissure veins were doubtless made by this agency.

A brief description of the rocks which are most important to consider is now necessary. Following our previous arrangement we shall divide them into

I. *Primary.*

II. *Metamorphic.*

III. *Stratified but not metamorphic.*

IV. *Eruptive.*

PRIMARY.

It is doubted by many geologists whether any true primary rock is known, all the older rocks being by them, called metamorphic, but others consider that *granite and syenite* are truly primary. They will be described therefore under this head:

GRANITE, a granular crystalline rock, consisting of *quartz, feld spar and mica* (see "MINERALOGY") having no appearance of layers in the arrangement of *mica*

or other ingredients. The *mica* is in scales usually white, black or brown, easily split by the point of a knife. The *quartz* is in glassy grains without any appearance of cleavage; the *feldspar* is generally whitish or flesh colored and shows a flat polished cleavage surface in one or two directions.

SYENITE, resembling granite, but contains *hornblende* instead of *mica*, sometimes the *quartz* is nearly wanting.

METAMORPHIC.

These rocks were originally stratified, but have been so altered by heat and pressure that the evidences of stratification have been much modified, and perhaps destroyed altogether as in the case of syenite and granite above mentioned. In addition to those rocks the following may be considered important.:

GNEISS resembling *granite*, but with the *mica* scales lying with their surfaces in the same general direction (as probably laid by the water originally). As the mica surfaces are in the same direction, gneiss shows a tendency to split somewhat readily into slabs; such a structure is called *schistose*. Gneiss is distinguished from granite by possessing this schistose structure. The structure of granite and syenite is *massive*, *i. e.*, they break as readily in one direction as another.

MICA SCHIST same as gneiss, but containing much more mica, glistening in lustre, easily breaking into

thin slabs; very schistose in structure; often *friable* or wearing easily. *Mica schist* may contain between its layers *plumbago, talc or hornblende* or other substances; it is then called *plumbaginous, talcose, hornblendic*, etc.

ARGYLLITE, CLAY SLATE OR ROOFING SLATE a very fine grained rock, of the same mineral composition as mica schist but distinct crystallization is not apparent; the iridescence of the mica is frequently noticeable in the sunlight; color is bluish, purplish, red, green and other colors and black.

As hornblende takes the place of the mica in granite to form syenite, so there is a series of hornblendic rocks corresponding to the foregoing, viz.

HORNBLENDIC GNEISS resembling gneiss, but having hornblende instead of mica.

HORNBLENDIC SCHIST a schistose rock consisting of greenish black hornblende and feldspar, or of *hornblende and quartz.*

PROTOGINE a granular, crystalline granite-like rock, composed of *quartz, feldspar and talc*, sometimes with a little *mica*, color grayish or greenish white.

CHLORITIC GNEISS a gneiss-like like rock containing in addition to *quartz, feldspar* and a little *mica, chlorite* in patches of soft olive green grains.

TALCOSE SCHIST a schistose or slaty rock containing *talc* instead of *mica*; it is sometimes almost wholly

talc and is then called *schistose talc*; gray or greenish in color; greasy to the touch and soft.

STEATITE OR SOAPSTONE, massive, fine and granular; gray or grayish green; feels soapy; composition talc; often contains other crystals.

CHLORITIC SCHIST like talcose schist but of an olive green or dark green color; less shining and less greasy to the feel; contains *chlorite* instead of *talc*.

SERPENTINE a massive rock without cleavage; resembling steatite but harder; easily scratched with a knife; dark green, yellowish green or mottled.

QUARTZITE a granular quartz rock usually white, gray or grayish red in color. Sometimes contains scales of mica or feldspar, and is then somewhat schistose. Only differs from ordinary sandstone by being closely consolidated apparently through partial fusion. *Jasper rock* is a flinty variety of quartzite, red, yellow or green in color.

ITACOLUMYTE a schistose quartzite containg also mica scales. The finer kind is sometimes flexible, and is called flexible sandstone. Occurs often in gold regions, assocated with talcose slates.

SPECULAR IRON ORE occurs as a rock of considerable thickness among the metamorphic rocks along with the hornblendic and chloritic rocks—it is generally dark in color having a steel blue color at a fracture and a red streak. Hardness six or seven.

MAGNETIC IRON generally black and associated with other rocks though sometimes in large separate bodies. In powder is strongly attracted by a magnet.

STATUARY MARBLE is metamorphic limestone, granular and crystalline in structure, white, gray or clouded in colòr.

DOLOMITE not easily distinguishable from the foregoing but less easily soluble in acids.

STRATIFIED BUT NOT METAMORPHIC.

These rocks are not of much importance in their bearing upon our subject as the mineral bearing veins are chiefly found in the metamorphic rocks described above. A brief statement in regard to them may not however be out of place. They are divided into two groups, viz.: *fragmental*, and *calcareous*.

The *fragmental* are sub-divided into

1. CONGLOMERATES a rock made of pebbles or fragments of any kind; if the pebbles are rounded the conglomerate is a *pudding stone*; if they are angular it is a *breccia*.

2. SANDSTONE a rock made of sand compacted; if it contains pebbles it is called a *grit*. Sandstones may be *silicious*, *granitic*, *porphyritic*, *basaltic*, *calcareous or marly* according to the material they contain.

3. SHALE a soft, fragile rock made from clay compacted. They are gray to black in color and may be

green, redish or purplish. *Bituminous shale, coaly shale and alum shale* are varieties.

4. TUFA an earthy rock, not very hard, made of fine volcanic rock or cinder often forming beds of great extent.

CALCAREOUS ROCKS.

1. LIMESTONE a compact massive rock scratched with a knife, effervescing in acids, burning to lime in a fire; color gray to black, sometimes bluish or reddish.

2. DOLOMITIC OR MAGNESIAN LIMESTONE similar to preceeding but not effervescing with acids and somewhat harder; the limestone of the older formations is frequently of this character.

ERUPTIVE ROCKS.

These rocks are igneous in character, and have been injected in a melted condition into dikes from which they have frequently overflowed upon the surface of the other rocks or have sometimes been forced laterally between the strata. In this latter case they assume falsely the appearance of having been themselves stratified. They may be divided into two groups, the *feldspathic* having low specific gravity and light colors; and the *augitic* having high specific gravity and dark colors.

The first of these (the *feldspathic*) consists mostly

of feldspar with disseminated crystals of *feldspar*, *hornblende or pyroxene*, color light gray, blue gray or grayish brown owing to the small quantity of iron. Some of the porphyries, however, are dark red or brown.

1. Feldspathic Trap (or Trap). Crystallized feldspar, white or light fawn color, smooth fracture.

2. Porphyry; compact, uncleavable, feldspar of grayish to red or brown color with pale crystals of feldspar disseminated through it giving it a spotted appearance, especially when polished.

3. Phonolite, (*clinkstone*) compact grayish blue or other colors, schistose or slaty often in structure, having a metallic ring under the hammer; tough and firm; having distinct crystals of feldspar throughout.

4. Trachyte, feldspar of pale color, fracture rough, usually porous, sometimes almost showing a cellular structure, sometimes with glassy feldspar crystals.

5. Pumice, very light and porous fibrous in structure, color generally light.

6. Obsidian a volcanic glass.

In the *augitic* series of lavas the most important are

1. Diorite granular containing *hornblende* and *albite* (*soda feldspar*), color grayish white to dark green.

2. BASALT compact, and containing glassy grains—dark color, crystallizing in columns often of great size.

Many of the metamorphic rocks have undergone partial fusion and closely resemble the eruptive rocks in structure: thus we have porphyritic gneiss, diorite and porphyry, among the metamorphic rocks as well as among the eruptive rocks.

FISSURE VEINS.

There has always been and is yet much dispute as to the manner in which veins have been formed and filled. The theory which seems on the whole most satisfactory is as follows:

Dikes of porphyritic or basaltic lavas coming up from the interior of the earth have heated and cracked the rocks in various directions; this lava is supposed to have originally contained the metallic ores distributed through them. Being more or less porous, however, in the course of time water penetratating them in every direction dissolved out the metallic ores and carried them down to lower levels, depositing them again with other materials, when the water evaporated or as the solution became stronger.

Thus the water oozing into the fissures and trickling down their sides and through the rock fragments between the walls left them coated with the various

spars and ores, which coat thickened until the spaces were filled and the vein completed. By this theory it is easily seen how hard fragments of the side walls, have come to be found within the fissure—how the veins come to be *banded*, etc.

Sometimes, however, this solution of mineral instead of getting into a fissure filtered down only to the *stratum* (of limestone or slate), onto which the lava had overflowed, and there deposited the minerals it carried.

In such cases where the mineral lies between two separate formations as for example, porphyry on one side and limestone on the other, we have what is called a *contact vein*. The ore may even have been carried down through one or two strata, thus may not have formed the contact vein, immediately under the igneous rock, but between two strata instead.

It will be noticed that this is a species of concentration process in which the very minute quantities of metal distributed throughout the large body of lava are collected by solution and brought together to a single or a very few fissure or contact veins.

The fissure or contact veins again have been ground off, and quantities of mineral have been deposited in the soil at greater or less depths; particularly is this the case where water has cut gulches across the veins and carried the vein matter down the streams covering it again with earth and rock. Material which has thus been washed away from its original location in

the vein is called *float*, and is sometimes found in such quantities as to justify great mining outlay. Of such character are the gulch and placer gold mines, and also without doubt many of the silver mines in the Leadville region.

A still different formation seems to occur where the dikes have not overflowed very considerably, but have simply filled the various cracks with some kind of lava. Here of course the ordinary mineral veins would not be found, but the water seems to have penetrated the lava and carrying down the ores until it reached some place of escape laterally—this it found when it reached some porous or soluble rock, some variety of limestome for example. Here the water dissolving out the limestone has deposited the metals in its stead in the shape of pockets or disseminated it through the rock. Various silver deposits in New Mexico and Southern Colorado seem to have been formed in this manner.

Veins may be of any thickness from that of a sheet of paper to one many rods in width. They may be clustered to form a net-work, or they may be few and distinct. Veins are occupied by *quartz*, *granite rocks*, *metallic ores*, *calcite*, *baryte* (*heavy spar*), *fluor spar*, etc., materials which were probably introduced by the agency of water and by that of Volcanic action.

A vein may be filled with one kind of material, e. g., quartz or granite, from side to side, or it may be banded vertically with different spars or ores, and gen-

erally speaking, these bands are nearly corresponding on either side of the seam, thus, if the layer next to one wall is quartz, the one next to the opposite wall is likely to be quartz also, if the next is calcite it is probably the same on the other side of the fissure and so on. This rule however is not true in every case, even for veins that show the banded structure most clearly. The simplest form of the banded vein is the three banded veins with the ore bearing band or *pay streak* in the center, and some spar calcite, fluor spar etc., or quartz on either side. The thickness of these bands may vary greatly at different depths, as also may that of the vein, but this is by no means—of itself a bad indication.

The mineral or rock material accompanying the ore is called the *vein stone* or *gangue*. The most common kind are *quartz*, *calcite*, *baryte and fluor spar*.

The vein is often called *lode or lead*. Nearly all veins have a *dip*, the sides of a vein are its walls. The *hanging wall* is the one which overhangs the vein; the opposite wall is the *foot wall*.

The *fluccan* is the half decomposed rock often found adjoining a vein.

The thin clayey layer along either side is called the *selvage or gouge*.

A *horse* is a body of rock of the same character as the wall rock occurring in the course of the vein.

A *comb* is one of the layers of a banded vein studded with crystals.

The best *strike* for a vein is that of the range in which it is found; the best *dip*, into the hill. Fine mines are sometimes found, however, as exceptions to this rule.

It often happens that a worthless vein at the surface improves on sinking until it may become very valuable.

A *fault* is occasioned where one vein interscets another; the *older vein* is faulted. The later vein which occasions the fault may be wide or narrow, the country rock on either side of it has slipped so that the older vein which originally was continuous is now suddenly terminated at the fault. The continuation of the vein, however, exists somewhere on the other side of the fault, and it is always difficult to judge whether or not it will be profitable to search for it. In case, however, the vein you are working is valuable and it is thought desirable to search for its continuation beyond the fault, it is generally safe to assume that the rock has slipped down the dip of the later intersceting vein. To ascertain this, supposing that you are running a level on the main vein and have reached the fault—lay bare the surface of the cross vein carefully and measure exactly its dip or that of its walls. If it dips downwards towards you in the level the rock on your side has slipped down, if it dips from you the other side has slipped. If the dip is somewhat to the right or left, which ever side has slipped has gone in that direction.

For example, supposing in meeting a fault you find that the dip is towards you and to the left. Your side has therefore slipped in that direction, and the continuation of the vein lies on the other side of the cross vein and to the right.

The rule then may be briefly stated as follows:

If the fault dips toward you and to the left or from you to the right, turn to the right after cutting through the cross vein. If the fault dips towards you and to the right or from you and to the left, turn to the left.

The walls of the cross vein are frequently scratched by the rubbing of the rocks against each other when they slipped, the direction and extent of these scratches should be studied as they frequently indicate the nature and extent of the *fault*.

PROSPECTING.

The chances for finding silver or gold formations are best among the older or metamorphic rocks or in the loose gravel and soil worn from them. The work requires patience and hard labor, accurate and keen perception, and all the knowledge of the subjects involved that can be got together.

Look first to the formation of the country and the general character of the country rock, this can be shown very well and quickly by the beds of the streams, each of which in every gravel bed carries a

history of the formations through which it flows. Fine and well worn pieces have come a long distance, large, angular and irregular fragments are not far from home.

Fragments of *vein stone* have when found a story to tell of their origion, and by following up the stream, examining carefully each fragment of spar, galena or quartz as it is found, the location of the vein from which they came may be very closely settled even when it is not definitely exposed. In examining for gold select a spot on one side of a stream bed at the foot of some steep descent—dig down through the sand or gravel, washing the dirt occasionally to see if there is any gold and continue it till you reach clay or bed rock, just above this you will find the gold if any has been brought down from above. If it is fine and in scales the vein is still some ways off. If it is in grains and nuggets even though quite small the vein is near by. The gulch deposits themselves are frequently rich.

Following the stream and tracing the fragments of vein stone back to their origin the vein itself may be approximately located. Sometimes especially when it possesses a quartz matrix which is harder than the country rock around, there will be a distinct outcrop which may be easily traced. In this case the claim may be laid out at once. In case, however, there is no outcrop examine the hill slopes in which the vein is supposed to lie, looking among the loose rock for

pieces of float. These pieces will always be found below the vein and where the soil or broken rock over the vein is deep they will be found on the surface only at a considerable distance away. By examining along the hill sides determine as well as possible the *strike* of the vein and at a point where the soil is shallow as near the vein as can be determined; dig trenches at right angles to the strike. Lay bare the surface of the solid rock. If you find float in the trench the vein is above you.

After finding the vein dig a short distance along the outcrop so as to determine its general direction. If the covering soil or rock is light it may be stripped off at intervals along the outcrop so as to expose as much of the vein as possible. If, however, it is deep it is best to run trenches across it at intervals of a hundred feet so that you may get a clear idea of its direction and size.

It seldom happens that a vein shows in its outcrop the same appearance of metallic ores which is found a little ways below the surface of the ground. Galena and the various ores of silver especially have probably been leached away by the action of water and the outcrop seems to be only a ridge of half decomposed quartz, iron stained; (known as honey combed quartz)or other vein stone. Copper generally shows its presence by green and blue stains over the surface.

Few veins are perpendicular but dip to one side or

the other; for this reason the outcrop follows a straight line only on level ground or regular slopes. In case the hill slope is variable, steep in places and gentle in others, the outcrop will follow a curved line. In case the vein dips to the right and your are following it up hill, in passing from a gentle to a steep slope the outcrop curves to the left, in passing over the crest of a steep slope to a gentle one it curves to the right. If the direction of the dip is to the left the rule is reversed. It is well to bear this in mind as it will save much trouble.

After determining the true line of the streak survey the claim and stake it off according to law. In sinking the first shaft select a point where the vein looks most promising and follow it down, exposing if possible both walls. If the vein is too wide to do this follow the paystreak down, and at intervals of thirty to fifty feet make cross cuts to the vein walls.

After the shaft is down one hundred feet run a level each way along the vein at least fifty feet being careful to keep within the side walls. By this time the mine should indicate its probable value. If, however, the results are not such as to show the mine to be valuable but are sufficiently good to warrant further exploration—push the shaft down another hundred feet and run a second level.

It frequently happens that ore at two hundred feet is valuable where that at one hundred feet was almost worthless. In this respect, however, you must be

guided by the experience of the mines in the vicinity.

It is assumed by many practical miners that the veins generally, but not invariably, trend from the southwest to the northeast, and that the richest veins of mineral are to be found upon the mountain summits or above timber line or upon the south and west sides—that we leave to the judgment of others.

You will always find more silver in galena of silicious deposits than in the galena of alkaline deposits.

It must be remembered that gold cannot be observed by the eye or magnifying lens when associated with galena, sulphide of zinc or arsenical pyrites. It is also sometimes found in connection with cobalt, manganese, lead, tellurium, malachite and the sulphides of silver and antimony.

Be always prepared to test the ores after you find them, either on the spot or after you return to camp. If not so prepared and desiring to procure an assay, send the ores put up in a small paper box or tobacco pouch, with label and stamp (properly protected against obliteration) to a competent and reliable assayer by mail or otherwise.

EXAMINATION OF MINES.

No business can compare with mining in offering splendid chances for achieving success or such ready opportunities for committing blunders and frauds. In no business, therefore, is there any greater necessity for securing the most entire honesty and capacity on the part of trusted agents.

The difficulty of forming a correct jndgment in either of these respects is the great source of mining mistakes and failures. This combined with the recklessness with which many people will invest their money in mining stocks without being able to form any clear judgment in the matter, makes the commission of the most glaring fraud, a comparatively easy matter.

Few people understand enough about mining to know that very poor mines may yield very rich specimens of mineral, and if the value of the mine be based on assays from them it will be indefinitely exaggerated.

It is always well to bear in mind a few facts in regard to the assays of ores.

Specimen assays are of use only to show the character of ore. As determining the value of the mine they had best be considered as entirely useless.

Assays of large quantities are of importance under

the following conditions: provided it is known that the ore was fairly and well averaged; that this average fairly represents all the ore or any given class of ore—that the proportion of gangue to the ore is stated; that the amount of work necessary to produce a given amount of such ore can be estimated.

Every assayer is of course interested in the welfare of the camp in which he is located, and the temptation to overstate the value of ores brought to him is always strong.

A false assay certificate may sometimes be bought or a correct one be altered to secure the sale of a mine. For this reason the character of the assayer should be satisfactory, and the certificate should be known to come directly from him and not to have been tampered with.

On the other hand assayers have been known to under value the ore brought to them for the purpose of buying up valuable pieces of property.

Again an assayer seldom knows where the ore he assays comes from. It is handed to him by the miner and *said to come* from such a mine—but the only surety for a fact is the word of the man who brings him the mineral.

Even when there is no doubt where the mineral came from, there are still many ways in which a false report may possibly be secured even from honest examiners and assayers. The mine may have been previously salted in a variety of ways; crevices may have been cleaned

out and rammed full of ore known to be valuable; or what is more difficult to detect if the ore is porous a solution of nitrate silver may be poured upon it, followed perhaps by one of salt water; this would occasion a deposit of chloride of silver in the cracks of the vein rock, and of course yield a high assay.

It sometimes happens that a purchaser is shown into a really good mine under the supposition that it was the one he was bargaining for, and finds out only after the purchase that he has never seen his property which of course turns out to be a valueless prospect.

In examining a mine the surveys should be closely inspected and compared with the vein on the ground, it sometimes happens that the fissure passes through only a small portion of the claim instead of its entire length as was supposed.

Besides the value and quantity of the ore in a vein it is important to notice its position, and accessibility, distance from wagon roads and railroads, the climate of the region, supplies of water, fuel, timber and other building materials, charcoal. etc. Also in addition to the richness of the ore its nature should be determined so as to show what mode of treatment would be needed.

The expense of the proper machinery should be taken into account as also the cost of mining, hauling and treating the ores. Only when the examiner of a mine has thoroughly satisfied himself on all these

points is he prepared to give an opinion as to the just value of the property.

A superintendent of a mine should be capable and honest, and if he is good one, deserves a good salary. He should understand assaying, chemistry, machinery, surveying and bookeeping, so as to know thoroughly well, all that is being done under his directions. The success or failure of the mine, provided of course that it is a good one, is almost entirely in his hands, and his opportunities for saving or wasting the funds of the company are numerous. A really good man is cheap at a large salary, and an incompetent one is dear at any price.

ADVICE TO PROSPECTORS.

In prospecting for mineral veins it is better for a party of three persons to associate themselves together for mutal aid and interest. One of the association can perform the duties required in camp, such as washing, cooking, hunting game and protecting the camp. The other two of the association can pursue prospecting, locating and working of claims. After working out the assessments required by law and securing the survey of the claim, one of the party can procure the filing and recording of the certificates of location, whilst the remaining two members of the association can protect the camp from thieves, and the claim or claims from being jumped by professional claim jumpers.

DANGER TO THOSE USING LIQUORS.—The use of spirituous liquors in high altitudes is more deleterious than in lower and miasmatic districts. The reason is obvious when it is known that the pulse is increased twelve beats per minute, and by the use of alcoholic drinks the arterial excitement is largely increased, which results evidently in severe febrile symptoms, paralysis or apoplexy.

HOW TO NEUTRALIZE ALKALINE WATERS.—In some localities the prospectors will find the waters highly impregnated with alkali, which produces an un-

pleasant, if not a serious, irritation of the mucous membrane of the stomach and urethra. Therefore it is well to be provided with a bottle of *lime juice*, a few drops of which dropped into each cup of water drank will neutralize the alkali in the water and thus render the alkali harmless.

CLIMATIC EFFECTS.—Those who visit high altitudes, in search of the precious ores, will be subject to difficult respiration, and should exercise a great degree of caution by protecting their persons with good woolen clothing, and have a heavy overcoat always at hand.

The changes are sudden and extreme, and the nights are always cool, and warm clothing is as necessary of summer nights, as in the winter.

Those that expose themselves, sooner or later become the victims of mountian fever. Those that are weak physically, are frequently attacked with hæmorrhage of the nose, lungs and bowels. Such persons should at once retire to the lower altitudes.

Persons who unnecessarily expose themselves are frequently attacked with pneumonia (inflammation of the lungs). Owing to the consequent acceleration of the arterial circulation it is difficult to arrest the progress of the disease. The surest means of recovery is to, at once, leave for lower altitudes for treatment.

Heat radiates with great rapidity on account of the many bare granitic mountains, which make a marked difference of temperature between day and night.

Catarrhal affections are prevalent, and also muscular

and acute rheumatism. Nature has provided a means of cure for the last named disease by resort to the many hot thermal springs.

CAMP OUT-FIT FOR THREE.—One tent, two or more woolen blankets each; one rubber blanket each; two pairs of rubber boots with high tops, for wading streams; one folding camp table; three folding camp stools; one iron frying pan; one bake oven; one granite coffee pot; six granite plates; six granite cups; two granite kettles; one granite bucket; six tin spoons, (three large and three small); three knives and three forks; one butcher knife; one coffee mill; needles, thread and buttons; can opener, cork screw, fishing hooks and lines; one field glass, for examining mountain formations inaccessible; one pocket lens; one pocket compass; one tape line; one axe; two prospecting picks; one drilling hammer, and sledge; two long handled shovels; one driller's spoon; three drills of Jessop's steel, one eighteen inches, one twenty-six inches, and one thirty-six inches long; five pounds giant powder; one box of caps and necessary fuse; one blow-pipe; soda, candles, charcoal, coffee, tea, sugar, flour, corn meal, onions, bacon or ham, dried apples, dried beef, pepper, salt, condensed milk, beans, dried peas, crackers, cheese, soap, molasses, baking powder, and all the canned goods that may be suited to the liking of the prospector.

In cooking provisions, particularly in boiling, you

will observe that it takes three times longer to boil in higher altitudes than in lower altitudes.

The prospector should wear heavy woolen clothes next to the person, and coat, pants and vest should be of the California cotton goods.

WARNING.—Giant powder is simply nitro-glycerine, absorbed by an absorbent in proportion of forty to seventy-five per cent. The absorbents used are generally infusorial earth, or a combination of the nitrate of soda and sawdust, or bituminous coal and sawdust, in the form of a round stick like molasses candy, with a greased paper surrounding it, and about eight inches long.

The explosion of giant powder is not caused by combustion, but by percussion. The manner of exploding the cartridge is thus: make a hole in one end of the cartridge with a knife or pencil and place the cap in the hole, and one end of the mining fuse in the cap, set fire to the other end of the fuse and retire to a safe distance.

Always bear in mind to have the drill of sufficient size to admit the giant powder cartridge without forcing the same down. Many serious accidents have occurred where the cartridge has been forced down too small a hole.

GRUB-STAKING.—This is a new-coined term used in mining camps. It is an outfit of tools and provisions supplied a prospector, who generally agrees to give,

in consideration of the outfit, one-half of any mines he may discover to the party furnishing such outfit. It also applies to a person who has discovered a mine and has not the means to live upon and operate it; then, in that case, a capitalist supplies the party with such provisions and appliances and takes an interest in the mine, as may be agreed upon between the parties.

In grub-staking it is necessary to make a memorandum of such contract properly signed, attested and recorded, and the same is binding between the parties.

GLOSSARY.

Acequia—A ditch for irrigating.
Adamantine—Any rock or ore of extreme hardness,
Adit—A level, a horizontal passage from the surface into a mine.
Alloy—A combination of one or more metals.
Altitude—Elevation of an object above the sea level.
Alluvium—Materials transported and deposited by water.
Aluminum—Metalic base of clay.
Amalgam—Gold or silver combined with mercury.
Amalgamating—A name applied to the process of separating gold and silver from their ore by mixing them with mercury.
Amorphous—Mineral substances not crystallized.
Apex—The top or highest point of a vein.
Arastra—A rude mill used by Mexicans for grinding ore to a powder.
Arborescent—Mineral of a leaf or twig-like form.
Argillaceous—Of clay-like character.
Assay—A test of mineral to determine quality and quantity.
Assessment—Percentage levied on the capital stock of a company, or the work required to be done annually on a mining claim.
Attrition—Wearing away by rubbing.
Attle—Waste Rock.
Auriferous—Any rock or sand bearing gold.
Augite—Composed of sand, lime and magnesia, with the oxide of iron or manganese.
Azurite—Blue copper ore.
Barium—Metalic base of barytes.
Barren Contact—A place in a contact without mineral.
Baryta—Barytes--The heaviest of all earthy matter. It is generally found in combination with sulphuric and carbonic acids, forming the sulphate and carbonate of baryta, known as heavy spar.
Basalt—Is composed of augite and feld-spar, and is generally of a dull green, brown, black, or grey tint, containing frequently magnetic iron or particles of olivine
Base Bullion—One or more metals in combination with lead after smelting and cast into an ingot.

Bed—A horizontal seam or deposit of ore.
Bed-rock—Rock underlying placer mines.
Black Jack—Zinc blende; sulphide of zinc.
Blende—An ore of zinc containing sulphur; sulphide of zinc.
Blind Lode—Where there appears no out-crop to a vein.
Blossom Rock—Detached ore or gangue rock indicating the presence of mineral veins.
Bonanza—Fair weather; a rich mine. (Spanish.)
Bosses—A rock studded with mineral, quartz, etc.
Boulders—Rounded masses of rock found out of place.
Breast—The face of a tunnel or drift
Breasting Ore—Ore taken from the end of a tunnel or face.
Breccia—Angular rocks cemented together presenting colors.
Budding—Separating ore by washing.
Bullion—Ingots of gold and silver ready for the mint.
Cage—An elevator used in hoisting ore, refuse, lowering material, men, cars, etc.
Canon—(Canyon)—A narrow passage through mountains; a deep chasm.
Calcareous—Anything containing lime.
Calcite—Carbonate of lime crystalized; calc-spar.
Calc—Sinter—Stalactitic carbonate of lime.
Calc—Tuff—A loose deposit of carbonate of lime; calcareous tufa.
Calcium—Metalic base of lime.
Cap-rock—Rock overlying the vein-stone or ore.
Carbon—One of the elementary constituents of the earth. It is the basis of all varieties of mineral-coal, graphite, commonly called plumbago, or black lead, of all animal and vegetable charcoal. The diamond is crystallized carbon.
Carboniferous—Formation containing coal.
Cheek—The side wall of a vein.
Chemical Composition—Definition see page 5, of mineralogy.
Chimney—This word is employed to designate those portions of a lode or vein which rise highest in the strata and lead down to the more regular fissure formation below.
Chlorides—A combination of chlorine and silver or other metals.
Chlorine—One of the elementary gases.
Chute—A channel made out of boards or logs down which to slide ore, waste rock, etc.
Claim—A tract of lands of the United States taken up by any one for mineral, homestead, etc.
Cleavage—Is the tendency of crystals, rocks or ore, to split in certain definite directions, but not in others.
Coaster—One who picks ore from the dumps.
Collar—The top of a shaft or winze.
Color—Definition see page 1 of mineralogy.
Comb--One of the layers of a banded vein studded with crystals.
Compact--A body that cannot be split.

Concentrating Ore -Ore may be concentrated in a variety of ways, according to its nature or composition. Usually the term, concentration, is meant to apply to those using mechanical processes such as washing, settling and jigging. Or, in the dry way, fanning by a current of air, by which lighter or barren portions are separated from the heavier or richer ones.

Conglomerate--Stones and pebbles cemented together.

Contact--A junction of two kinds of rock, such as lime and porphyry.

Contact Vein--A vein between two dissimilar rock masses.

Contiguous--In close or actual contact.

Country--The ground traversed by a vein.

Country-rock--The rock on each side of a vein.

Crevice--A fissure; a split or crack.

Cribbing--Timbers used in confining walls of a vein in place.

Cropping Out--When mineral or rock appears at the surface.

Cross-cut--A level driven across the course of a vein.

Crucible--A pot used for melting mineral. There are several kinds and qualities named Hessian clay, Black lead, French, Meissen and Berlin crucibles.

Crystal-form—Definition see page 4 of mineralogy.

Cube—It is a body having six equal square sides, with equal angles.

Cupel—A small bone-ash cup used by assayers.

Cut—Where a mineral vein is intersected, crossed or divided.

Debris—The refuse from mines; or it is applied to a collection of the larger fragments of rock and strata, to distinguish it from detritus, or those which are pulverized.

Dendritical—Silver appearing like tree branches.

Denudation—The uncovering of rocks by water or other agencies.

Deposit—The term is generally used to designate ore not confined to a lode.

Dip—The slope or pitch of a vein or mine.

Diluvium—A surface deposit of sand, pebbles, gravel, loam, etc.

Disintegrated—Rocks decomposed by atmospheric, aqueous, and other agencies, and reduced to sand, gravel, etc.

Disseminated--Where the mineral is distributed through the vein-stone.

Dolomite—A crystalline magnesian carbonate of lime; much of the building marble is dolomite.

Drift—A passage under ground from shaft to shaft, or a passage driven in search of ore; it is also a term applied by geologists to earth and rocks that have been drifted and deposited by water.

Ductile—A mineral that is malleable and can be drawn out into wire or sheets.

Dump—Is a place of deposit for ore and refuse.

Dike—Is a wall of rock or mineral thrown upward; an intrusion of melted matter into rents or fissures of rocks.

Elastic—Anything bent without breaking and returning to its original form.

Exploitation—The working of a mine; the amount of work done. (French.)

Face—The end of a drift or tunnel.

Fault—The displacement of a stratum or vein.
Feeder—A small vein entering into a larger vein.
Ferruginous—Anything containing iron in solution or composition.
Filament, Filiform, } Is the name of mineral of a thread-like appearance.
Fissure-vein—A crack in the earth's crust containing mineral.
Flint—A species of quartz, of a yellowish, bluish, or blackish grey color.
Float—Loose quartz, calc spar, fluor spar, heavy spar or detached mineral.
Fluccan—A half decomposed rock often found adjoining a vein.
Flume—Pipe, box or trough used in conveying water.
Fluoride—A combination of fluorine with a metal.
Flux—Substance used to promote fusion of metals or ores.
Foot-wall—Rock beneath a vein.
Free-gold—Gold easily separated from the gangue-rock, gravel or dirt.
Gad—A small pointed wedge.
Galena—Sulphide of lead.
Gash-vein—A vein wide at the top and closing at a short depth.
Geode—A rounded nodule of stone containing a cavity studded with crystals.
Gypsiferous—Partaking of the nature of gypsum; plaster of paris; sulphate of lime.
Gypsum—Sulphate of lime; when burned and ground fine is called plaster of paris; when white, fine grained and translucent it is called *alabaster.*
Gulcina—Oxide of glucinum.
Gulcinum—A metal in form of a greyish black powder which assumes a dark metallic lustre by rubbing.
Gneiss—(Nice). Metamorphic rock resembling granite.
Gouge—A clay streak found next to the walls of a fissure vein.
Granitoid—Resembling granite.
Gulch—A ravine; dry water course; a gully.
Hanging-wall—A layer of rock or wall overhanging a lode.
Hardness—Definition see page 2 of mineralogy.
Heading--A vein of ore above a drift.
Headings--Gravel above the head of a sluice.
Hexagonal--A crystal having six sides and six angles.
High grade ore--Whether an ore is to be classed as "*High Grade Ore*" depends upon the nature of the ore, which determines the process to be used in extraction of the silver. For instance, an ore with 50 per cent of lead and 50 ounces of silver per ton would be classed *High Grade* as a *Smelting Ore*; but if it contained 50 ounces of *Silver and no lead*, it would be classed *Low Grade Ore*, whether at a smelting or amalgamating mill. Again, 100 ounce ore with no lead, would be called *High Grade Ore* as an amalgamating ore, and *Low Grade Ore* as a smelting ore. But generally, 40 ounces and under in any silver ore may be classed as *Low Grade*, though many smelting ores thus classed will pay handsomely if plentiful enough.
Horse—A mass of rock between the branches of a vein.
Hydrogen—One of the elements of water; the lightest substance known.

Hyacinth—A red, ferruginous quartz, of a blood-red color; sometimes of a redish orange; also brown.
Incline drift—An inclined passage way under ground.
Indurated—Any substance becoming hardened.
Ingot— A mass of gold, silver or other metal cast into a mould.
Igneous—The igneous rocks are those rocks whose structure is attributable to heat, such as porphyry, etc.
Infiltration—Water penetrating the interstices or cavities of a body.
In place—Not having been disturbed from its original position, and not separated from the entire mineral body.
Iridescence—A gleaming of colors.
Jig--A machine for concentrating ore by means of water.
Jumping a claim--Relocating a claim made by another in the absence of the original claimant, or by force.
Lagging--The timbers over and upon the sides of a drift.
Laminæ--Thin sheets or scales of a mineral.
Lead-granulated—Pure lead used in assaying.
Ledge, lode or lead—Mineral ores and gangue confined within fissure veins.
Level—A horizontal passage in a mine diverging from the shaft.
Lixiviation—This term is used for all processes in which the ground ore or "pulp" is treated by chemicals in the wet way. There are many different processes, but all include treatment of the wet pulp by suitable chemicals.
Lode—A belt or sheet of mineral bearing rock, having definite boundaries and clearly separated from neighboring rocks.
Low grade ore—See high grade ore.
Lustre—The gleam or polish of a mineral. See page 1 of mineralogy.
Magnesium--Metallic base of magnesia.
Magnesia--A soft white powder, without taste or smell; oxide of magnesium.
Malleable--A metal that will flatten under the hammer.
Manganese--A Metal of a whitish grey color to a dusky white, very hard and difficult to fuse.
Marl-- a mixture of lime and clay.
Massive--In a mass; having a crystaline structure.
Matrix--The same as gangue or vein stone.
Metallic--Like a metal in lustre and substance.
Metallurgy--The science of testing, assaying or separating the metals from their ores.
Mill-run--A test of the value of an ore from a large quantity.
Nodules--A rounded mineral mass of irregular shape.
Octahedron—A solid, with eight triangular plane faces; two four-sided pyramids base to base.
Opaque—Not transmitting light.
Opal—*Fire Opal*—A silicious gem of red and yellow flame colors. *Common Opal*—Has a milky appearance.

Out-crop—The portion of a vein showing at the surface.
Oxide—A compound of oxygen with any other single element.
Panning-out—Paying well; in panning gold where considerable is found.
Pay-rock—Lode mineral in which ore is found.
Pearl-spar—Brown spar; a magnesian carbonate of lime colored by the oxide of lime or manganese.
Petering—Giving out; failing.
Pitch—A slope or dip.
Placer—A deposit of mineral, particularly gold, in sand or gravel.
Plane—A flat, regular surface, as of still water.
Pocket—A rich spot in a vein or deposit.
Porphyry—A rock consisting of a compact feldspathic base, through which are scattered crystals of feld-spar of various colors, sometimes white; the term is often applied to other rocks of compact uniform base, which contains crystals of another mineral.
Primary—Is the first in order of development of the earth's crust.
Precipitated—Cast or thrown down as a sediment.
Prospecting—Searching for mineral veins or deposits.
Pudding-stone—A coarse sandstone composed of pebbles; flints cemented together.
Quartz—Glassy Variety:—*Amethyst*--color purple or bluish violet.
Rose Quartz--Pink colored; much fractured.
Citrine or Topaz--Yellow color.
Cairngorm--A yellowish crystal or false topaz.
Milky Quartz--Greasy feel.
Leek or Green Quartz--Colored with the silicate of iron.
Aventurine--Spangled with yellow colored mica; sometimes gray, brown, or reddish brown in color.
Iron Colored Quartz--Yellow, brownish yellow, or red.
Semi-transparent Variety--*Chalcedony*--White, bluish and brown.
Chrysoprase--Apple-green color.
Carnelian--Bright red color, with clear rich tint.
Sardonyx--Deep brownish red.
Agate--Variegated colored lines; sometimes looks like moss inclosed.
Onyx--Variety of colors in horizontal layers.
Cat's Eye--Greyish green color.
Flint Hornstone--Smoky gray, brown and even black; partly translucent.
Jasper, or Opaque Variety--*Heliotrope or Bloodstone*--Contains alumina and oxide of iron.
Touch Stone or Lydian Stone--Velvet black color; used to detect gold.
Basanite--Black jasper or flinty slate.
Pseudo-Morpheus--Imperfectly crystallized.
Wood Jasper--Wood mineralized by silicious petrefaction; yellowish brown.
Hydrophane--White; a variety of opal.

Quartz—Porphyry--Consists of well marked grains, blebs or crystals; color, flesh red, reddish brown, purple, yellow, bluish slate grey and white; mica or hornblende gives dark gray, brown or greenish tints.

Quartz--Trachyte--It presents a glassy, enamel like, or porcellaneous character under the magnifying lens.

Quartzose--Resembles quartz in nature and characteristics.

Re-agents--Chemicals employed to detect the presence of metal.

Reducing--The process of extracting the metal from the ore.

Reniform--A Kidney-shaped ore.

Reticulated--Ore resembling net work.

Resinous—Resembling common resin.

Ruby—1st. *Spinelle*--Is orange red and violet brown; consists of alumina and magnesia, with iron and chromium.

2d. *Pyrope*--Is the silicate of magnesia and alumina, with iron as coloring matter.

Salting a Mine—Placing foreign ore in the crevices of a vein for the purpose of deceiving.

Sapphire—It is nearly pure alumina with iron as coloring matter, and next to diamond in hardness.

Schistose--Rocks admitting divisions into flags, slabs or slates.

Sectile—See page 3 of mineralogy.

Selvage—Thin band of earthy matter between the walls and vein.

Shaft—A well-like excavation.

Shale—A fine grained sedimentary rock, having a slaty structure.

Slag—Waste from smelters; scum, dross, vitrified cinders, etc.

Slimes—Ore crushed fine in the mills or vein.

Sluices—Troughs through which water is run to wash out gold.

Smelting—The reduction of ores by fire.

Sodium—Metalic base of soda.

Spars—*Calc Spar*—Crystalline carbonate of lime of various shades of grey, white, green or yellow.

Feld Spar--See four distinct kinds described on page 8.

Fluor Spar—Fluoride of lime, clear, green and yellow colors.

Heavy Spar--Sulphate barium, white, red, yellow, etc.

Pearl Spar--Magnesian carbonate of lime of pearly lustre.

Volcanic Spar--Fused feld spar.

Spathose—Having a sparry appearance.

Specific Gravity—Definition see page 4 of mineralogy. SP. GR. in the table indicates specific gravity.

Stamps--Machines for crushing ores.

Stope--To excavate in the form of steps.

Stoping--The act of excavating the ore from the roof or floor of a drift with a pick; the former is overhand stoping; the latter underhanded stoping.

Strike--The extension of a lode in a horizontal direction; valuable mineral development made unexpectedly.

Streak--Definition see page 2 of mineralogy.

Stulls--A frame work to support the rubbish when stoping.

Sump--A hole in the bottom of a shaft or tunnel for collecting the water.
Tabular--Definition see page 4 of mineralogy.
Tailings--The refuse left after washing or smelting ores, generally containing ores or metals not recovered.
Talc--A magnesian mineral of smooth surfaces, greasy feel, shining lustre, translucent and easily scratched by the finger nail.
Tenacity--Definition see page 7 of mineralogy.
Tender-foot—A novice in the art of mining and without knowledge of prospecting for minerals.
Tertiary—A late geological period; see table page 43.
Test-lead—Lead refined and granulated for assayers.
Trachyte—A species of lava in which feld-spar predominates; when feld-spar crystals are thickly and uniformly disseminated through the mass it is called trachyte porphyry.
Translucent--Transmitting light, but not clear, like horn.
Triturate--To grind or pulverize.
Tunnel--A level driven across a vein.
Tufa--**Tuff**--1st, a volcanic sandstone.
2d, a soft porous rock deposited by water, usually calcareous.
Turquoise--Hydrated phosphate of alumina of a bluish green.
Utahcerite--A new mineral wax or paraffine found in the canons of Utah by Prof. Clayton, similar to ozocerite found in Moldavia.
Vein--An aggregation of mineral matter in rock fissure. (See lode.)
Vitreous--Having the appearance of glass.
Whim--A machine for raising ore and refuse.
Winze--A shaft sunk from one level to another.

UNITED STATES MINING LAWS.

MINERAL LANDS RESERVED.

SECTION 2318. In all cases lands valuable for minerals shall be reserved from sale, except as otherwise expressly directed by law.

MINERAL LANDS SUBJECT TO PURCHASE.

SEC. 2319. All valuable mineral deposits in lands belonging to the United States, both surveyed and unserveyed, are hereby declared to be free and open to exploration and purchase, and the lands in which they are found to occupation and purchase, by citizens of the United States and those who have declared their intention to become such, under regulations prescribed by law, and according to the local customs or rules of miners in the several mining districts, so far as the same are applicable and not inconsistent with the laws of the United States.

LENGTH OF MINING-CLAIMS.

SEC. 2320. Mining claims upon veins or lodes of quartz or other rock in place bearing gold, silver, cinnabar, lead, tin, copper, or other valuable deposits, heretofore located, shall be governed as to length along the vein or lode by the customs, regulations, and laws in force at the date of their location. A mining-claim located after the tenth day of May, eighteen hundred and seventy-two, whether located by one or more persons, may equal, but shall not exceeed, one thousand five hundred feet in length along the vein or lode; but no location of a mining-claim shall be made until the discovery of the vein or lode within the limits of the claim located. No claim shall extend more than three hundred feet on each side of the middle of the vein at the surface, nor shall any claim be limited by any mining regulation to less than twenty-five feet on each side of the middle of the vein at the surface, except where adverse rights existing on the the tenth day of May, eighteen hundred and seventy-two, render such limitation necessary. The end-lines of each claim shall be parallel to each other.

PROOF OF CITIZENSHIP.

SEC. 2321. Proof of citizenship, under this chapter, may consist, in the case of an individual of his own affidavit thereof; in the case of an association of persons unincorporated, of the affidavit of their authorized agent, made on his own knowledge, or upon information and belief; and in the case of a corporation organized under the laws of the United States, or of any state or territory thereof, by the filing of a certified copy of their charter or certificate of incorporation.

LOCATOR'S RIGHTS.

SEC. 2322. The locators of all mining locations heretofore made, or which shall hereafter be made, on any mineral vein, lode, or ledge, situated on the public domain, their heirs and assigns, where no adverse claim exists on the tenth day of May, eighteen hundred and seventy-two, so long as they comply

with the laws of thd United States, and with state, territorial and local regulations not in conflict with the laws of the United States governing their possessory title, shall have the exclusive right of possession and enjoyment of all the surface included within the lines of their locations, and of all veins, lodes and ledges throughout their entire depth, the top or apex of which lies inside of such surface lines extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side-lines of such surface locations. But their right of possession to such outside parts of such veins or ledges should be confined to such portions thereof as lie between vertical planes drawn downward as above described, through the end-lines of their location so continued in their own direction that such planes will intersect such exterior parts of such veins or ledges. And nothing in this section shall authorize the locator or possessor of a vein or lode which extends in its downward course beyond the vertical lines of his claim to enter upon the surface of a claim owned or possessed by another.

OWNER'S OF TUNNELS.

SEC. 2323. Where a tunnel is run for the development of a vein or lode, or for the discovery of mines, the owners of such tunnel shall have the right of possession of all veins or lodes within three thousand feet from the face of such tunnel on the line thereof, not previously known to exist, discovered in such tunnel, to the same extent as if discovered from the surface; and locations on the line of such tunnel or veins or lodes not appearing on the surface, made by other parties after the commencement of the tunnel, and while the same is being prosecuted with reasonable diligence, shall be invalid; but failure to prosecute the work on the tunnel for six months shall be considered as an abandonment of the right to all undiscovered veins on the line of such tunnel.

REGULATIONS MADE BY MINERS.

SEC. 2324. The miners of each mining district may make regulations not in conflict with the laws of the United States, or with the laws of the State or territory in which the district is situated, governing the location, manner of recording, amount of work necessary to hold possession of a mining-claim, subject to the following requirements: The location must be distinctly marked on the ground so that its boundaries can be readily traced. All records of mining-claims hereafter made shall contain the name or names of the locators, the date of the location, and such a description of the claim or claims located by reference to some natural object or permanent monument as will identify the claim. On each claim located after the tenth day of May, eighteen hundred and seventy-two, and until a patent has been issued therefor, not less than one hundred dollars' worth of labor shall be performed or improvements made during each year. On all claims located prior to the tenth day of May, eighteen hundred and seventy-two, ten dollars' worth of labor shall be performed or improvements made, by the tenth day of June, eighteen hundred and seventy-four, and each year thereafter, for each one hundred feet in length, along the vein until a patent has been issued therefor; but where such claims are held in common, such expenditure may be made upon any one claim; and upon a failure to comply with these conditions, the claim or mine upon which such failure occurred shall be open to relocation in the same manner as if no location of the same had ever been made, provided that the original locators, their heirs, assigns, or legal representatives, have not resumed work upon the claim after failure and before such location. Upon the failure of any one of several co-owners to contribute his proportion of the expenditures required hereby, the co-owners who have performed the labor or made the improvements may, at the expiration of the year, give such delinquent co-owner personal notice in writing, or notice by publication in the newspaper published nearest the claim, for at least once a week for ninety days, and if at the expiration of

ninety days after such notice in writing or publication such delinquent should fail or refuse to contribute his proportion of the expenditure required by this section, his interest in the claim shall become the property of his co-owners who have made the required expenditures. *Provided*, that the period within which the work required to be done annually on all unpatented mineral claims shall commence the first day of January succeeding the date of location of such claim, and this section shall apply to all claims located since the tenth day of May, A. D. eighteen hundred and seventy-two. (That section two thousand three hundred and twenty-four of the revised statues be, and the same is hereby amended so that where a person or company has or may run a tunnel for the purpose of developing lode or lodes, owned by said person or company, the money so expended in said tunnel shall be taken and considered as expended on said lode or lodes, whether located prior to or since the passage of said act, and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same as required by said acts. Amended February 11, 1875.)

PATENTS FOR MINERAL LANDS.

SEC. 2325. A patent for any land claimed and located for valuable deposits may be obtained in the following manner: Any person, association or corporation authorized to locate a claim under this chapter, having claimed and located a piece of land for such purposes, who has, or have, complied with the terms of this chapter, may file in the proper land office an application for a patent, under oath, showing such compliance, together with a plat and field-notes of the claim or claims in common, made by or under the direction of the United States surveyor-general, showing accurately the boundaries of the claim or claims, which shall be distinctly marked by monuments on the ground, and shall post a copy of such plat, together with a notice of such application for a patent, in a conspicuous place on the land embraced in such plat previous to the filing of the application for a patent, and shall file an affidavit of at least two persons that such notice has been duly posted, and shall file a copy of the notice in such land-office, and shall thereupon be entitled to a patent for the land, in the manner following: The register of the land-office, upon the filing of such application, plat, field-notes, notices, and affidavits, shall publish a notice that such application has been made, for the period of sixty days, in a newspaper to be by him designated as published nearest to such claim; and he shall also post such notice in his office for the same period. The claimant at the time of filing this application, or any time thereafter, within the sixty days of publication, shall file with the register a certificate of the United States surveyor-general that five hundred dollars' worth of labor has been expended or improvements made upon the claim by himself or grantors; that the plat is correct, with such further description by such reference to natural objects or permanent monuments as shall identify the claim, and furnish an accurate description, to be incorporated in the patent. At the expiration of the sixty days of publication the claimant shall file his affidavit, showing that the plat and notice have been posted in a conspicuous place on the claim during the period of publication. If no adverse claims shall have been filed with the register and the receiver of the proper land-office at the expiration of the sixty days of publication, it shall be assumed that the applicant is entitled to a patent, upon the payment to the proper officer of five dollars per acre, and that no adverse claim exists; and thereafter no objection from third parties to the issuance of a patent shall be heard, except it be shown that the applicant has failed to comply with the terms of this chapter. *Provided*, that when the claimant of a patent is not a resident of the land district wherein the vein, lode, ledge, or deposit sought to be patented is located, the affidavits required to be made in this section by the claimant for such patent may be made by his, her or its authorized agent, where said agent is conversant with the facts sought to be established by said affidavits: And *provided*, that this section shall apply to all applications now pending for patents to mineral lands. Sec. 6, May 10, 1872.

ADVERSE CLAIMS.

SEC. 2326. Where an adverse claim is filed during the period of publication, it shall be upon oath of the person or persons making the same, and shall show the nature, boundaries, and extent of such adverse claim, and all proceedings, except the publication of notice and making and filing of the affidavit thereof, shall be stayed until the controversy shall have been settled or decided by a court of competent jurisdiction, or the adverse claim waived. It shall be the duty of the adverse claimant, within thirty days after filing his claim, to commence proceedings in a court of competent jurisdiction, to determine the question of the right of posession, and prosecute the same with reasonable dilligence to final judgment; and a failure so to do shall be a waiver of his adverse claim. After such judgment shall have been rendered, the party entitled to the possession of the claim, or any portion thereof, may, without giving further notice, file a certified copy of the judgment-roll with the register of the land-office, together with a certificate of the surveyor-general that the requisite amount of labor has been expended, or improvements made thereon, and the description required in other cases, and shall pay to the receiver five dollars per acre for his claim, together with the proper fees, whereupon the whole proceedings and the judgment-roll shall be certified by the register to the commissioner of the general land office, and a patent shall issue thereon for the claim, or such portion thereof as the applicant shall appear, from the decision of the court, to rightly possess. If it appears from the decision of the court that several parties are entitled to separate and different portions of the claim, with the proper fees, and file the certificate and the description by the surveyor-general, whereupon the register shall certify the proceedings and judgment-roll to the commissioner of the general land office, as in the preceding case, and patents shall issue to the several parties according to their respective rights. Nothing herein contained shall be construed to prevent the alienation of the title conveyed by a patent for a mining-claim to any person whatever. Sec. 7, May 10, 1872.

CLAIMS ON SURVEYED AND UNSURVEYED LANDS.

SEC. 2327. The description of vein or lode claims, upon surveyed lands, shall designate the location of the claim with reference to the lines of the public surveys, but need not conform therewith; but where a patent shall be issued for claims upon unsurveyed lands, the surveyor-general, in extending the surveys, shall adjust the same to the boundaries of such patented claim, according to the plat or description thereof, but so as in no case to interfere with or change the location of any such patented claim.

EXISTING RIGHTS.

SEC. 2328. Applications for patents for mining-claims under former laws now pending may be prosecuted to a final decision in the general land office; but in such cases, where adverse rights are not affected thereby, patents may issue in pursuance of the provisions of this chapter; and all patents for mining claims upon veins or lodes heretofore issued, shall convey all the rights and priveliges conferred by this chapter where no adverse rights existed on the tenth day of May, eighteen hundred and seventy two.

PLACER-CLAIMS, LIMIT OF

SEC. 2329. Claims usually called "placers," including all forms of deposit, excepting veins of quartz or other rock in place, shall be subject to entry and patent, under like circumstances and conditions, and upon similar proceedings, as are provided for vein or lode claims; but where the lands have been previously surveyed by the United States, the entry in its exterior limits shall conform to the legal subdivisions of the of the public lands.

MAXIMUM OF PLACER LOCATIONS.

SEC. 2330. Legal subdivisions of forty acres may be sub-divided into ten-acre tracts; and two or more persons, or associations of persons, having contiguous claims of any size, although such claims may be less than ten acres each, may make joint entry thereof; but no location of a placer-claim, made after the ninth day of July, eighteen hundred and seventy, shall exceed one hundred and sixty acres for any one person or association of persons, which location shall conform to the United States surveys; and nothing in this section contained shall defeat or impair any bona fide pre-emption or homestead claim upon agricultural lands or authorize the sale of the improvements of any bona fide settler to any purchaser.

LIMITATION OF CLAIMS.

SEC. 2331. Where placer claims are upon surveyed lands, and conform to legal subdivisions, no further survey or plat shall be required, and all placer-mining claims located after the tenth day of May, eighteen hundred and seventy-two, shall conform as near as practicable with the United States system of public land-surveys, and the rectangular subdivisions of such surveys, and no location shall include more than twenty acres for each individual claimant; but where placer-claims cannot be conformed to legal subdivisions, survey and plat shall be made as on unsurveyed lands; and where by the segregation of mineral lands in any legal subdivision a quantity of agricultural land less than forty acres remains, such fractional portion of agricultural land may be entered, by any party qualified by law, for homestead or pre-emption purposes.

EVIDENCE OF POSSESSION A RIGHT TO A PATENT.

SEC. 2332. Where such person or association, they and their grantors, have held and worked their claims for a period equal to the time prescribed by the statute of limitations for mining-claims of the state or territory where the same may be situated, evidence of such possession and working of the claims for such period shall be sufficient to establish a right to a patent thereto under this chapter, in the absence of any adverse claim; but nothing in this chapter shall be deemed to impair any lien which may have attached in any way whatever to any mining-claim or property thereto attached prior to the issuance of a patent.

PATENT FOR PLACER-CLAIM.

SEC. 2333. Where the same person, association or corporation is in possession of a placer-claim, and also a vein or lode included within the boundaries thereof, application shall be made for a patent for the placer-claim, with the statement that it includes such vein or lode, and in such case a patent shall issue for the placer-claim, subject to the provisions of this chapter, including such vein or lode, upon the payment of five dollars per acre for such vein or lode claim, and twenty-five feet of surface on each side thereof. The remainder of the placer-claim, or any placer-claim not embracing any vein or lode claim, shall be paid for at the rate of two dollars and fifty cents per acre, together with all costs of proceedings; and where a vein or lode, such as is described in section twenty-three hundred and twenty, is known to exist within the boundaries of a placer-claim, an application for a patent for such placer-claim which does not include an application for the vein or lode claim shall be construed as a conclusive declaration that the claimant of the placer-claim has no right of possession of the vein or lode claim; but where the existence of a vein or lode in a placer-claim is not known, a patent for the placer-claim shall convey all valuable mineral and other deposits within the boundaries thereof.

APPOINTMENT OF SURVEYORS OF MINING CLAIMS.

SEC. 2334. The surveyor-general of the United States may appoint in each land-district containing mineral lands as many competent surveyers as shall apply for appointment to survey mining-claims. The expenses of the survey of vein or lode-claims, and the survey and subdivision of placer-claims into smaller quantities than one hundred and sixty acres, together with the cost of publication of notices, shall be paid by the applicants, and they shall be at liberty to obtain the same at the most reasonable rates, and they shall also be at liberty to employ any United States deputy-surveyor to make the survey. The commissioner of the general land-office shall also have power to establish the maximum charges for surveys and publication of notices under this chapter; and, in case of excessive charges for publication, he may designate any newspaper published in a land district where mines are situated for the publication of mining notices in such district, and fix the rates to be charged by such paper; and, to the end that the commissioner may be fully informed on the subject, each applicant shall file with the register a sworn statement of all charges and fees paid by such applicant for publication and surveys, together with all fees and money paid the register and the receiver of the land-office, which statement shall be transmitted, with the other papers in the case, to the commissioner of the general land-office.

AFFIDAVITS.

SEC. 2335. All affidavits required to be made under this chapter may be verified before any officer authorized to administer oaths within the-land district where the claims may be situated, and all testimony and proofs may be taken before any such officer, and, when duly certified by the officer taking the same, shall have the same force and effect as if taken before the register and receiver of the land-office. In cases of contest as to the mineral or agricultural character of the land, the testimony and proofs may be taken as herein provided on personal notice of at least ten days to the opposing party; or if such party cannot be found, then by publication of at least once a week for thirty days in a newspaper, to be designated by the register of the land-office as published nearest to the location of such land; and the register shall require proof that such notice has been given.

INTERSECTION OF MINERAL VEINS.

SEC. 2336. Where two or more veins intersect or cross each other, priority of title shall govern; and such prior location shall be entitled to all ore or mineral contained within the space of intersection; but the subsequent location shall have the right of way through the space of intersection for the purposes of the convenient working of the mine. And where two or more veins unite, the oldest or prior location shall take the vein below the point of union, including all the space of intersection.

NON MINERAL LANDS.

SEC. 2337. Where non-mineral land not contiguous to the vein or lode is used or occupied by the proprietor of such vein or lode for mining or milling purposes, such non-adjacent surface-ground may be embraced and included in an application for a patent for such vein or lode, and the same may be patented therewith, subject to the same preliminary requirements as to survey and notice as are applicable to veins or lodes; but no location hereafter made of such non-adjacent land shall exceed five acres, and payment for the same must be made at the same rate as fixed by this chapter for the superficies of the lode. The owner of a quartz-mill or reduction works, not owning a mine in connection therewith, may also receive a patent for his mill-site, as provided in this section.

LOCAL LEGISLATION.

SEC. 2338. As a condition of sale, in the absence of necessary legislation by congress, the local legislature of any state or territory may provide rules for working mines, involving easements, drainage, and other necessary means to their complete development; and those conditions shall be fully expressed in the patent. Sec. 5, July 26, 1866.

RIGHTS OF WATER FOR MINING—RIGHT OF WAY FOR CANALS.

SEC. 2339. Whenever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other puroses, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same; and the right of way for the construction of ditches and canals for the purposes herein specified is acknowledged and confirmed; but whenever any person, in the construction of any ditch or canal, injures or damages the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage.

SEC. 2340. All patents granted, or pre-emption or homesteads allowed, shall be subject to any vested and accrued water-rights, or rights to ditches and reservoirs used in connection with such water-rights, as may have been acquired under or recognized by the preceding section.

MINERAL LANDS OPEN TO HOMESTEADS.

SEC. 2341. Wherever, upon the lands heretofore designated as mineral lands, which have been excluded from survey and sale, there have been homesteads made by citizens of the United States, or persons who have declared their intention to become citizens, which homesteads have been made, improved, and used for agricultural purposes, and upon which there have been no valuable mines of gold, silver, cinnabar, or copper discovered, and which are properly agricultural lands, the settlers or owners of such homesteads shall have a right of pre-emption thereto, and shall be entitled to purchase the same at the price of one dollar and twenty-five cents per acre, and in quantity not to exceed one hundred and sixty acres; or they may avail themselves of the provisions of chapter five of this title, relating to "HOMESTEADS."

MINERAL LANDS AS AGRICULTURAL LANDS.

SEC. 2342. Upon the survey of the lands described in the preceding section, the secretary of the interior may designate and set apart such portions of the same as are clearly agricultural lands, which lands thereafter shall be subject to pre-emption and sale as other public lands, and shall be subject to all the laws and regulations applicable to the same.

COAL LANDS.

SEC. 2347. Every person above the age of twenty-one years, who is a citizen of the United States, or who has declared his intention to become such, or any association of persons severally qualified as above, shall, upon application to the Register of the proper Land Office, have the right to enter, by legal subdivisions, any quantity of vacant coal lands of the United States not otherwise appropriated or reserved by competent authority, not exceeding one hundred and sixty acres to each individual person; or three hundred and twenty acres to such association, upon payment to the Receiver of not less than ten dollars per acre for such lands, where the same shall be situated more than fifteen miles from any completed railroad, and not less than twenty dollars per acre for such lands as shall be within fifteen miles of such road. Sec. 1, March 3, 1873.

SEC. 2348. Any person, or association of persons severally qualified as above provided, who have opened and improved, or shall hereafter open and improve, any coal mine or mines upon the public lands, and shall be in actual possession of the same, shall be entitled to a preference right of entry, under the preceding section, of the mines so opened and improved. *Provided*, Than when an association of not less than four persons, severally qualified as above provided, shall have expended not less than five thousand dollars in working and improving any such mine or mines, such association may enter not exceeding six hundred and forty acres including such mining improvements. Sec. 2, Ibid.

SEC. 2349. All claims under the preceding section must be presented to the register of the proper land district within sixty days after date of actual possession and the commencement of improvements on the land by the filing of a declaratory statement therefor; but when the township plat is not on file at the date of such improvement, filing must be made within sixty days from the receipt of such plat at the district office; and where the improvements shall have been made prior to the expiration of three months from the third day of March, eighteen hundred and seventy-three, sixty days from the expiration of such three months shall be allowed for the filing of a declaratory statement, and no sale under the provisions of this section shall be allowed until the expiration of six months from the third day of March, eighteen hundred and seventy three. Sec. 3, Ibid.

SEC. 2350. The three preceding sections shall be held to authorize only one entry by the same person or association of persons; and no association of persons, any member of which shall have taken the benefit of such sections; either as an individual or as a member of any other association, shall enter or hold any other lands under the provisions; and all persons claiming under section twenty three hundred and forty-eight shall be required to pay their respective rights and pay for the lands filed upon within one year from the time prescribed for filing their respective claims; and upon failure to file the proper notice, or to pay for the land within the required period, the same shall be subject to entry by any other qualified applicant. Sec. 4, Ibid.

SEC. 2351. In case of conflicting claims upon coal lands where the improvement shall have commenced after the third day of March, eighteen hundred and seventy-three, priority of possession and improvement followed by proper filing and continued good faith, shall determine the preference right to purchase. And also when improvements have already been made prior to the third day of March, eighteen hundred and seventy-three, division of the land claimed may be made by legal subdivisions, to include as near as may be the valuable improvements of the respective parties. The Commissioner of the general land office is authorized to issue all needful rules and regulations for carrying into effect the provisions of this and the four preceding sections. Sec. 5, Ibid.

SEC. 2352. Nothing in the five preceding sections shall be construed to destroy or impair any rights which may have attached prior to the third day of March, eighteen hundred and seventy-three, or to authorize the sale of lands valuable for mines of gold, silver or copper. Sec. 6, Ibid.

AN ACT PERMITTING THE FELLING AND USE OF TIMBER.

SECTION 1. All citizens of the United States, and other persons, *bona fide* residents of the state of Colorado or Nevada, or either of the territories of New Mexico, Arizona, Utah, Wyoming, Dakota, Idaho, or Montana, and all other mineral districts of the United States, shall be, and are hereby authorized and permitted to fell and remove, for building, agri-

cultural, mining or other domestic purposes, any timber or other trees growing or being on the public lands, said lands being mineral, and not subject to entry under existing laws of the United States, except for mineral entry in either of said states, territories or districts of which said citizens or persons may at the time be *bona fide* residents, subject to such rules and regulations as the secretary of the interior may prescribe for the protection of the timber and of the undergrowth growing upon such lands, and for other purposes: *Provided*, The provisions of this act shall not extend to railroad corporations.

SEC. 2. That it shall be the duty of the register and the receiver of any local land-office in whose district any mineral land may be situated to ascertain from time to time whether any timber is being cut or used upon any such lands, except for the purposes authorized by this act, within their respective land districts; and, if so, they shall immediately notify the commissioner of the general land-office of that fact; and all necessary expenses incurred in making such proper examinations shall be paid and allowed such register and receiver in making up their next quarterly accounts.

SEC. 3. Any person or persons who shall violate the provisions of this act, or any rules and regulations in pursuance thereof made by the secretary of the interior, shall be deemed guilty of a misdemeanor, and upon conviction shall be fined in any sum not exceeding five hundred dollars and to which may be added imprisonment for any term not exceeding six months.

Approved June 3, 1878.

LAND OFFICE RULES.

EXPLORATION, OCCUPATION AND PURCHASE.

1. It will be perceived that, by the foregoing provisions of law the mineral lands in the public domain, surveyed or unsurveyed, are open to exploration, occupation, and purchase, by all citizens of the United States and all those who have declared their intention to become such.

LODE-CLAIMS PRIOR TO MAY 10, 1872.

2. By an examination of the several sections of the revised statutes it will be seen that the *status* of lode-claims located *previous* to the tenth of May, 1872, is not changed with regard to their *extent along the lode or width of surface*.

3. Mining rights acquired under such previous locations are, however, enlarged by said revised statutes in the following respect, viz: The locators of all such previously taken veins or lodes, their heirs and assigns, so long as they comply with the laws of congress, and with state, territorial, or local regulations not in conflict therewith, governing mining-claims, are invested with the exclusive possessory right of all the surface included within the lines of their locations, and of all veins, lodes, or ledges, throughout their entire depth, the top or apex of which lies inside of such surface-lines extended downward vertically, although such veins, lodes, or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side-lines of such locations at the surface, it being expressly provided, however, that the right of possession to such outside parts of said veins or ledges shall be confined to such portions thereof as lie between vertical planes drawn downward as aforesaid, through the end-lines of their locations, so continued in their own direction that such planes will intersect such exterior parts of such veins, lodes, or ledges; no right being granted, however, to the claimant of such outside portion of a vein or ledge to enter upon the surface location of another claimant.

4. It is to be distinctly understood, however, that the law limits the possessory right to veins, lodes, or ledges, *other* than the one named in the original location, to such as were not *adversely claimed on May* 10, 1872, and that where such other vein or ledge was so adversely claimed at that date, the right of the party so adversely claiming is in no way impaired by the provisions of the revised statutes.

5. In order to hold the possessory title to a mining-claim located prior to May 10, 1872, and for which a patent has not been issued, the law requires that *ten dollars* shall be expended annually in labor or improvements on each of *one hundred feet* on the course of the vein or lode until a patent shall have been issued therefor; but where a number of such claims are held in common upon the same vein or lode the aggregate expenditure that would be necessary to hold all the claims, at the rate of ten dollars per one hundred feet, may be made upon any one claim; a failure to comply with this requirement in any one year subjecting the claim upon which such failure occurred to relocation by other parties, the same as if no previous location thereof had ever been made, unless the claimants under the original location shall have resumed work thereon after such failure and before such relocation. The first annual expenditure upon claims of this class should have been performed subsequent to May 10, 1872, and prior to January 1, 1875. From and after January 1, 1875, the required amount must be expended *annually*, until patent issues. By decision of the honorable secretary of the interior, dated March 4, 1879, such annual expenditures are not required subsequent to entry, the date of issuing the patent certificate being the date contemplated by the statute.

6. Upon the failure of any one of several co-owners of a vein, lode, or ledge, which has not been entered, to contribute his portion of the expenditures necessary to hold the claim or claims so held in ownership in common, the co-owners who have performed the labor, or made the improvements, as required by said revised statutes, may, at the expiration of the year, give such delinquent co-owner personal notice in writing, or notice by publication in the newspaper published nearest the claim, for at least once a week for ninety days; and if upon the expiration of ninety days after such notice in writing, or upon the expiration of one hundred and eighty days after the first newspaper publication of notice, the delinquent co-owner shall have failed to contribute his proportion to meet such expenditure or improvements, his interest in the claim by law passes to his co-owners, who have made the expenditures of improvements as aforesaid.

PATENTS HERETOFORE ISSUED.

7. Rights under patents for veins or lodes heretofore granted under previous legislation of congress are enlarged by the revised statutes so as to invest the patentee, his heirs or assigns, with title to all veins, lodes or ledges, throughout their entire depth, the top or apex of which lies within the end or side boundary-lines of his claim on the surface, as patented, extended downward vertically, although such veins, lodes or ledges may so far depart from a perpendicular in their course downward as to extend outside the vertical side-lines of the claim at the surface. The right of possession to such outside parts of such veins or ledges to be confined to such portions thereof as lie between vertical planes drawn downward through the end-lines of the claims at the surface, so continued in their own direction that such planes will intersect such exterior parts of such veins or ledges, it being expressly provided, however, that all veins, lodes, or ledges, the top or apex of which lies inside such surface locations, *other* than the one named in the patent, which were *adversely claimed on the 10th day of May*, 1872, are excluded from such conveyance by patent.

8. Applications for patents for mining-claims pending at the date of the act of May 10, 1872, may be prosecuted to final decision in the general land-office, and where no adverse rights are affected thereby, patents will be issued in pursuance of the provisions of the revised statutes.

LOCATING CLAIMS ON VEINS OR LODES.

9. From and after the 10th of May, 1872, any person who is a citizen of the United States or who has declared his intention to become a citizen, may locate, record and hold a mining-claim, *of fifteen hundred linear feet* along the course of any mineral vein or lode subject to location; or an association of persons, severally qualified as above, may make joint location of such claim of *fifteen hundred feet*, but in no event can a location of a vein or lode made subsequent to May 10, 1872, exceed fifteen hundred feet along the course thereof, whatever may be the number of persons composing the association.

10. With regard to the extent of surface ground joining a vein or lode, and claimed for the convenient working thereof; the revised statutes provide that the lateral extent of locations of veins or lodes made after May 10, 1875, shall in no case *exceed three hundred feet on each side of the middle of the vein at the surface*, and that no such surface rights shall be limited by any mining regulations to any less than twenty-five feet on each side of the middle of the vein at the surface, except where adverse rights existing on the 10th of May, 1872, may render such limitation necessary; the end lines of such claims to be in all cases parallel to each other. Said lateral measurements cannot extend beyond three hundred feet on *either* side of the middle of the vein at the surface, or such distance as is allowed by local laws. For example: four hundred feet cannot be taken on one side and two hundred feet on the other. If, however, three hundred feet on each side are allowed, and by reason of prior claims but one hundred feet can be taken on one side, the locator will not be restricted to less than three hundred feet on the other side; and when the locator does not determine by exploration *where* the middle of the vein at the surface is, his discovery shaft must be assumed to mark such point.

11. By the foregoing it will be perceived that no lode-claim located after the 10th of May, 1872, can exceed a parallelogram fifteen hundreed feet in length by six hundred feet in width, but whether surface ground of that width can be taken, depends upon the local regulations or state or territorial laws, in force in the several mining districts; and that no such local regulations, or state or territorial laws shall limit a vein or lode claim to less than fifteen hundred feet along the course thereof, whether the location is made by one or more persons, nor can surface-rights be limited to less than fifty feet in width, unless adverse claims existing on the 10th day of May, 1872, render such lateral limitation necessary.

12. It is provided by the revised statutes that the miners of each district may make rules and regulations not in conflict with the laws of the United States, or of the state or territory in which such districts are respectively situated, governing the location, manner of recording, and amonut of work necessary to hold possession of a claim. They likewise declare that the location shall be so distinctly marked on the ground that its boundaries may be readily traced. This is a very important matter, and locators cannot exercise too much care in defining their locations at the outset, inasmuch as the law requires that all records of mining locations made subsequent to May 10, 1872, shall contain the name or names of the locators, the date of the location, and such a *description of the claim or claims* located, by reference to some natural object or permanent monument, as will identify the claim.

13. The statutes provide that no lode-claim shall be recorded until after the discovery of a vein or lode within the limits of the ground claimed; the object of which provision is evidently to prevent the encumbering of the dis-

trict mining records with useless locations before sufficient work has been done thereon to determine whether a vein or lode has really been discovered or not.

14. The claimant should therefore, prior to recording his claim, unless the vein can be traced upon the surface sink a shaft, or run a tunnel or drift, to a sufficient depth therein to discover and develop a mineral-bearing vein, lode, or crevice; should determine, if possible, the general course of such vein in either direction from the point of discovery, by which direction he will be governed in marking the boundaries of his claim on the surface, and should give the course and distance as nearly as practicable from the discovery-shaft on the claim to some permanent, well-known points or objects, such, for instance, as stone monuments, blazed trees, the confluence of streams, points of intersection of well-known gulches, ravines or roads, prominent buttes, hills, etc., which may be in the immediate vicinity, and which will serve to perpetuate and fix the *locus* of the claim, and render it susceptible of identification from the description thereof given in the record of locations in the district.

15. In addition to the foregoing data, the claimant should state the names of adjoining claims, or, if none adjoin, the relative positions of the nearest claims; should drive a post or erect a monument of stones at each corner of his surface-ground, and at the point of discovery or discovery-shaft should fix a post, stake, or board, upon which should be designated the name of the name of the lode, the name or names of the locators, the number of feet claimed, and in which direction from the point of discovery, it being essential that the location notice filed for record, in addition to the foregoing description, should state whether the entire claim of fifteen hundred feet is taken on one side of the point of discovery, or whether it is partly upon one and partly upon the other side thereof, and in the latter case, how many feet are claimed upon each side of such discovery-point.

16. Within a reasonable time, say twenty days after the location shall have been marked on the ground, or such time as is allowed by the local laws, notice thereof accurately describing the claim in manner aforesaid, should be filed for record with the proper recorder of the district, who will thereupon issue the usual certificate of location.

17. In order to hold the possessory right to a location made since May 10, 1872, not less than one hundred dollars' worth of labor must be performed, or improvements made thereon, within one year from the date of such location, and annually thereafter; in default of which the claim will be subject to re-location by any other party having the necessary qualifications, unless the original locator, his heirs, assigns, or legal representatives, have resumed work thereon after such failure and before such relocation.

18. The expenditures made upon mining-claims may be made from the surface or in running a tunnel for the development of such claims, the act of February 11, 1875, providing that where a person or company has, or may, run a tunnel for the purpose of developing a lode or lodes owned by said person or company, the money so expended in said tunnel shall be taken and considered as expended on said lode or lodes, and such person or company shall not be required to perform work on the surface of said lode or lodes in order to hold the same.

19. The importance of attending to these details in the matter of location, labor, and expenditure, will be more readily perceived when it is understood that a failure to give the subject proper attention may invalidate the claim.

TUNNEL RIGHTS.

20. Section 2323 provides that where a tunnel is run for the development of a vein or lode, or for the discovery of mines, the owners of such tunnel shall have the right of possession of all veins or lodes within three thousand feet from the face of such tunnel on the line thereof, not previously known to exist, discovered in such tunnel, to the same extent as if discovered from the surface; and locations on the line of such tunnel or veins or lodes not appearing on the surface, made by other parties after the commencement of the tunnel, and while the same is being prosecuted with reasonable diligence, shall be invalid; but failure to prosecute the work on the tunnel for six months shall be considered as an abandonment of the right to all undiscovered veins or lodes on the line of said tunnel.

21. The effect of this is simply to give the proprietors of a mining-tunnel run in good faith the possessory right to fifteen hundred feet of any blind-lodes cut, discovered or intersected by such tunnel, which were not previously known to exist, within three thousand feet from the face or point of commencement of such tunnel, and to prohibit other parties, after the commencement of the tunnel, from prospecting for and making locations of lodes on the *line thereof* and within said distance of three thousand feet, unless such lodes appear upon the surface or were previously known to exist.

22. The term "face," as used in said section, is construed and held to mean the first working-face formed in the tunnel, and to signify the point at which the tunnel actually enters cover; it being from this point that the three thousand feet are to be counted, upon which prospecting is prohibited as aforesaid.

23. To avail themselves of the benefits of this provision of law, the proprietors of a mining-tunnel will be required, at the time they enter cover as aforesaid, to give proper notice of their tunnel location, by erecting a substantial post, board, or monument, at the face or point of commencement thereof, upon which should be posted a good and sufficient notice, giving the names of the parties or company claiming the tunnel-right; the actual or proposed course or direction of the tunnel; the height and width thereof, and the course and distance from such face or point of commencement to some permanent well-known objects in the vicinity by which to fix and determine the *locus* in manner heretofore set forth applicable to locations or veins or lodes, and at the time of posting such notice they shall, in order that miners or prospectors may be enabled to determine whether or not they are within the lines of the tunnel, establish the boundary lines thereof, by stakes or monuments placed along such lins at proper intervals, to the terminus of the three thousand feet from the face or point of commencement of the tunnel, and the lines so marked will define and govern as to the specific boundaries within which prospecting for lodes not previously known to exist is prohibited while work on the tunnel is being prosecuted with reasonable diligence.

24. At the time of posting notice and marking out the lines of the tunnel as aforesaid, a full and correct copy of such notice of location defining the tunnel-claim must be filed for record with the mining recorder of the district, to which notice must be attached a sworn statement or declaration of the owners, claimants or projectors of such tunnel, setting forth the facts in the case; stating the amount expended by themselves and their predecessors in interest in prosecuting work thereon; the extent of the work performed, and that it is *bona fide* their intention to prosecute work on the tunnel so located and described with reasonable diligence for the development of a vein or lode, or for the discovery of mines, or both, as the case may be.

This notice of location must be duly recorded, and, with the said sworn statement attached, kept on the recorder's file for future reference.

25. By a compliance with the foregoing much needless difficulty will be avoided, and the way for the adjustment of legal rights acquired in virtue of said section 2323 will be made much more easy and certain.

26. This office will take particular care that no improper advantage is taken of this provision of law by parties making or professing to make tunnel locations, ostensibly for the purposes named in the statute, but really for the purpose of monopolizing the lands lying in front of their tunnels to the detriment of the mining interests and to the exclusion of *bona fide* prospectors or miners, but will hold such tunnel claimants to a strict compliance with the terms of the statutes; and a *reasonable diligence* on their part in prosecuting the work is one of the essential conditions of their implied contract. Negligence or want of due diligence will be construed as working a forfeiture of their right to all undiscovered veins on the line of such tunnel.

TITLE TO VEIN OR LODE CLAIMS.

27. By section 2325 authority is given for granting titles for mines by patent from the government to any person, association, or corporation, having the necessary qualifications as to citizenship and holding the right of possession to a claim in compliance with law.

28. The claimant is required in the first place to have a correct survey of his claim made under authority of the surveyor-general of the state or territory in which the claim lies; such survey to show with accuracy the exterior surface boundaries of the claim, which boundaries are required to be distinctly marked by monuments on the ground. Four plats and one copy of the original field-notes, in each case, will be prepared by the surveyor-general; one plat and the original field-notes to be retained in the office of the surveyor-general, one copy of the plat to be given to the claimant for posting upon the claim, one plat and a copy of the field-notes to be given the claimant for filing with the proper register, to be finally transmitted by that officer, with other papers in the case, to this office, and one plat to be sent by the surveyor-general to the register of the proper land-district to be retained on his files for future reference.

29. The claimant is then required to post a copy of the plat of such survey in a conspicuous place upon the claim, together with notice of his intention to apply for a patent therefor, which notice will give the date of posting, the name of the claimant, the name of the claim, mine, or lode; the mining district and county; whether the location is of record, and, if so, where the record may be found; the number of feet claimed along the vein and the presumed direction thereof; the number of feet claimed on the lode in each direction from the point of discovery, or other well-defined place on the claim; the name or names of adjoining claimants on the same or other lodes; or, if none adjoin, the names of the nearest claims, etc.

30. After posting the said plat and notice upon the premises, the claimant will file with the proper register and receiver a copy of such plat, and the field-notes of the survey of the claim, accompanied by the affidavit of at least two credible witnesses that such plat and notice are posted conspicuously upon the claim, giving the date and place of such posting; a copy of the *notice* so posted to be attached to, and form a part of, said affidavit.

31. Attached to the field-notes so filed must be the sworn statement of the claimant that he has the possessory right to the premises therein described, in virtue of a compliance by himself (and by his grantors, if he claims by purchase) with the mining rules, regulations, and customs of the mining-dis-

trict, state, or territory in which the claim lies, and with the mining laws of congress; such sworn statement to narrate briefly, but as clearly as possible the facts constituting such compliance, the origin of his possession, and the basis of his claim to a patent.

32. This affidavit should be supported by appropriate evidence from the mining recorder's office to his possessory right, as follows, viz: Where he claims to be a locator, a full, true and correct copy of such location should be furnished, as the same appears upon the mining records; such copy to be attested by the seal of the recorder, or if he has no seal, then he should make oath to the same being correct, as shown by his records; where the applicant claims as locator, in company with others who have since conveyed their interests in the lode to him, a copy of the original record of location should be filed, together with an abstract of title from the proper recorder, under seal or upon oath as aforesaid, tracing the co-locator's possessory rights in the claim to such applicant for patent; where the applicant claims only as a purchaser for valuable consideration, a copy of the location record must be filed, under seal or upon oath as aforesaid, with an abstract of title certified as above by the proper recorder, tracing the right of possession by a continuous chain of conveyances from the original locators to the applicant.

33. In the event of the mining records in any case having been destroyed by fire or otherwise lost, affidavit of the fact should be made, and secondary evidence of possessory title will be received, which may consist of the affidavit of the claimant, supported by those of any other parties cognizant of the facts relative to his location, occupancy, possession, improvements, etc.; and in such case of lost records, any deeds, certificates of location or purchase, or other evidence which may be in the claimant's possession, and tend to establish his claim should be filed.

34. Upon the receipt of these papers the register will, at the expense of the claimant (who must furnish the agreement of the publisher to hold applicant for patent alone responsible for charges of publication), publish a notice of such application for the period of sixty days, in a newspaper published nearest to the claim; and will post a copy of such notice in his office for the same period. In all cases sixty days must intervene between the first and last insertion of the notice in such newspaper. When the notice is published in a *weekly* newspaper ten consecutive insertions are necessary; when in a *daily* newspaper the notice must appear in each issue for the required period.

35. The notices so published and posted must be as full and complete as possible, and embrace all the *data* given in the notice posted upon the claim.

36. Too much care cannot be exercised in the preparation of these notices, inasmuch as upon their accuracy and completeness will depend, in a great measure, the regularity and validity of the whole proceeding.

37. The claimant, either at the time of filing these papers with the register, or at any time during the sixty days' publication, is required to file a certificate of the surveyor-general that not less than five hundred dollars' worth of labor has been expended or improvements made upon the claim by the applicant or his grantors; that the plat filed by the claimant is correct; that the field-notes of the survey, as filed, furnished such an accurate description of the claim as will, if incorporated into a patent, serve to fully identify the premises, and that such reference is made therein to natural objects or permanent monuments as will perpetuate and fix the *locus* thereof.

38. It will be the more convenient way to have this certificate indorsed by the surveyor-general, both upon the plat and field-notes of survey filed by the claimant as aforesaid.

39. After the sixty days' period of newspaper publication has expired the claimant will file his affidavit, showing that the plat and notice aforesaid remained conspicuously posted upon the claim sought to be patented during the sixty days' publication, giving the dates.

40. Upon the filing of this affidavit the register will, if no adverse claim was filed in his office during the period of publication, permit the claimant to pay for the land according to the area given in the plat and field-notes of survey aforesaid, at the rate of five dollars for each acre and five dollars for each fractional part of an acre, the receiver issuing the usual duplicate receipt therefor. The claimant will also make a sworn statement of all charges and fees paid by him for publication and surveys, together with all fees and money paid the register and receiver of the land-office, after which the whole matter will be forwarded to the commissioner of the general land-office and a patent issued thereon if found regular.

41. In sending up the papers in the case, the register must not omit certifying to the fact that the notice was posted in his office for the full period of sixty days, such certificate to state distinctly when such posting was done and how long continued.

42. The consecutive series of numbers of mineral entries must be continued, whether the same are of lode or placer-claims.

43. The surveyor-general must continue to designate all surveyed mineral claims as heretofore by a progressive series of numbers, beginning with lot No. 37 in each township; the claim to be so designated at date of filing the plat, field-notes, etc., in addition to the local designation of the claim; it being required in all cases that the plat and field-notes of a survey of a claim must, in addition to the reference to permanent objects in the neighborhood, describe the *locus* of the claim with reference to the lines of public surveys by a line connecting a corner of the claim with the nearest public corner of the United States surveys, unless such claim be on unsurveyed lands at a remote distance from such public corner, in which latter case the reference by course and distance to permanent objects in the neighborhood will be a sufficient designation by which to fix the *locus* until the public surveys shall have been closed upon its boundaries.

44. Section 2326 provides for adverse claims, fixes the time within which they shall be filed to have legal effect, and prescribes the manner of their adjustment.

45. Said section requires that the adverse claim shall be filed during the period of publication of notice; that it must be on the oath of the adverse claimant; and that it must show the "*nature*," the "*boundaries*," and the "*extent*" of the adverse claim.

46. In order that this section of law may be properly carried into effect, the following is communicated for the information of all concerned:

47. An adverse mining-claim must be filed with the register of the same land-office with whom the application for patent was filed, or in his absence with the receiver, and within the sixty days' period of newspaper publication of notice.

48. The adverse notice must be duly sworn to by the person or persons making the same before an officer authorized to administer oaths within the land-district, or before the register or receiver; it will fully set forth the nature and extent of the interference or conflict, whether the adverse party

claims as a purchaser for valuable consideration or as a locator; if the former, a certified copy of the original location, the original conveyance, a duly certified copy thereof, or an abstract of title from the office of the proper recorder should be furnished, or if the transaction was a mere verbal one he will narrate the circumstances attending the purchase, the date thereof, and the amount paid, which facts should be supported by the affidavit of one or more witnesses, if any were present at the time, and if he claims as a locator he must file a duly certified copy of the location from the office of the proper recorder.

49. In order that the "*boundaries*" and "*extent*" of the claim may be shown, it will be incumbent on the adverse claimant to file a plat showing his entire claim, its relative situation or position with the one against which he claims, and the extent of the conflict. This plat must be made from an actual survey by a United States deputy-surveyor, who will officially certify thereon to its correctness, and in addition there must be attached to such plat of survey a certificate or sworn statement by the surveyor as to the approximate value of the labor performed, or improvements made upon the claim by the adverse party or his predecessors in interest, and the plat must indicate the position of any shafts, tunnels, or other improvements, if any such exist, upon the claim of the party opposing the application, and by which party said improvements were made.

50. Upon the foregoing being filed within the sixty days as aforesaid, the register, or in his absence, the receiver, will give notice in writing to *both parties* to the contest that such adverse claim has been filed, informing them that the party who filed the adverse claim will be required within thirty days from the date of such filing to commence proceedings in a court of competent jurisdiction to determine the question of right of possession, and to prosecute the same with reasonable diligence to final judgment, and that should such adverse claimant fail to do so, his adverse claim will be considered waived, and the application for patent be allowed to proceed upon its merits.

51. When an adverse claim is filed as aforesaid, the register or receiver will indorse upon the same the precise date of filing, and preserve a record of the date of notifications issued thereon; and thereafter all proceedings on the application for patent will be suspended, with the exception of the completion of publication and posting of notices and plat, and the filing of the necessary proof thereof, until the controversy shall have been adjudicated in court, or the adverse claim waived or withdrawn.

52. The proceedings after rendition of judgment by the court in such case are so clearly defined by the act of itself as to render it unnecessary to enlarge thereon in this place.

PLACER-CLAIMS.

53. The proceedings to obtain patents for claims usually called placers, including all forms of deposit, are similar to the proceedings prescribed for obtaining patents for vein or lode claims; but where said placer-claim shall be upon surveyed lands, and conform to legal subdivisions, no further survey or plat will be required, and all placer-mining claims located after May 10, 1872, shall conform as nearly as practicable with the United States system of public land surveys and the rectangular subdivision of such surveys, and no such location shall include more than twenty acres for each individual claimant; but where placer-claims cannot be conformed to legal subdivisions, sur-

vey and plat shall be made as on unsurveyed lands. But where such claims are located previous to the public surveys, and do not conform to legal subdivisions, survey, plat, and entry thereof, may be made according to the boundaries thereof, provided the location is in all respects legal.

54. The proceedings for obtaining patents for veins or lodes having already been fully given, it will not be necessary to repeat them here; it being thought that careful attention thereto by applicants and the local officers will enable them to act understandingly in the matter and make such slight modifications in the notice, or otherwise, as may be necessary, in view of the different nature of the two classes of claims, placer-claims being fixed, however, at two dollars and fifty cents per acre, or fractional part of an acre.

55. By section 2330, authority is given for the subdivision of forty-acre legal subdivisions in *ten-acre* lots, which is intended for the greater convenience of miners in segregating their claims both from one another and from intervening agricultural lands.

56. It is held, therefore, that under a proper construction of the law these ten-acre lots in mining districts should be considered and dealt with, to all intents and purposes, as legal subdivisions, and that an applicant having a legal claim which conforms to one or more of these ten-acre lots, either adjoining or cornering, may make entry thereof after the usual proceedings, without further survey or plat.

57. In cases of this kind, however, the notice given of the application must be very specific and accurate in description, and as the forty-acre tracts may be subdivided into ten-acre lots, either in the form of squares of ten by ten chains or of parallelograms five by twenty chains, so long as the lines are parallel and at right angles with the lines of the public surveys, it will be necessary that the notice and application state specifically what ten-acre lots are sought to be patented, in addition to the other *data* required in the notice.

58. Where the ten-acre subdivision is in the form of a square, it may be described for instance, as the "S. E. ¼ of the S. W. ¼ of N. W. ¼," or, if in the form of a parallelogram as aforesaid, it may be described as the "W. ½ of the W. ½ of the S. W. ¼ of the N. W. ¼ (or the N. ½ of the S. ½ of the N. E. ¼ of the S. E. ¼) of section ————, township ————, range ————," as the case may be; but in addition to this description of the land, the notice must give all the other *data* that is required in a mineral application, by which parties may be put on inquiry as to the premises sought to be patented. The proof submitted with applications for claims of this kind must show clearly the character and the extent of the improvements upon the premises.

59. Applicants for patent to a placer-claim, who are also in possession of a known vein or lode included therein, must state in their application that the placer includes such vein or lode. The published and posted notices must also include such statement; and the vein or lode must be surveyed or marked upon the plat; the field notes and plat giving the area of the lode claim or claims and the area of the placer separately. If veins or lodes lying within a placer location are owned by other parties, the fact should be distinctly stated in the application for patent, and in all the notices. It should be remembered that an application which omits to include an application for a known vein or lode therein, must be construed as a conclusive declaration that the applicant has no right of possession to the vein or lode. Where there is no known lode or vein, the fact must appear by the affidavit of claimant and one or more witnesses.

60. When an adverse claim is filed to a placer application, the proceedings are the same as in the case of vein or lode claims, already described.

PLACER GROUND SUBJECT TO LOCATION.

61. By section 2330 it is declared that no location of a placer-claim, made after July 9, 1870, shall exceed one hundred and sixty acres for any person or association of persons, which location shall conform to the United States surveys.

62. Section 2331 provides that all placer-mining claims, located after May 10, 1872, shall conform as nearly as practicable with the United States system of public surveys, and the subdivisions of such surveys, and no such locations shall include more than twenty acres for each individual claimant

63. The foregoing provisions of law are construed to mean that after the 9th day of July, 1870, no location of a placer-claim can be made to exceed one hundred and sixty acres, whatever may be the number of locators associated together, or whatever the local regulations of the district may allow; and that from and after May 10, 1872, no location made by an individual can exceed twenty acres, and no location made by an association of individuals can exceed one hundred and sixty acres, which location of one hundred and sixty acres cannot be made by a less number than eight *bona fide* locators; and no local laws or mining regulations can restrict a placer location to less than twenty acres, although the locator is not compelled to take so much.

64. The regulations hereinbefore given as to the manner of marking locations on the ground and placing the same on record, must be observed in the case of placer locations, so far as the same are applicable; the law requiring, however, that where placer-claims are upon *surveyed* public lands the locations must hereafter be made to conform to legal subdivisions thereof as near as practicable.

65. With regard to the proofs necessary to establish the possessory right to a placer-claim, section 2332 provides that "where such person or association, they and their grantors, have held and worked their claims for a period equal to the time prescribed by the statute of limitations for mining-claims of the state or territory where the same may be situated, evidence of such possessions and working of the claims for such period shall be sufficient to establish a right to a patent thereto under this chapter, in the absence of any adverse claim."

66. This provision of law will greatly lessen the burden of proof, more especially the case of old claims located many years since, the records of which, in many cases, have been destroyed by fire, or lost in other ways during the lapse of time, but concerning the possessory right to which all controversy or litigation has long been settled.

67. When an applicant desires to make his proof of his possessory right in accordance with this provision of law, you will not require him to produce evidence of location, copies of conveyances, or abstracts of title, as in other cases, but will require him to furnish a duly certified copy of the statute of limitations of mining-claims for the state or territory, together with his sworn statement, giving a clear and succinct narration of the facts as to the origin of his title, and likewise as to the continuation of his possession of the mining-ground covered by his application, the area thereof, the nature and extent of the mining that has been done thereon; whether there has been any opposition to his possession, or litigation with regard to his claim, and, if so, when the same ceased; whether such cessation was caused by compromise or

by judicial decree, and any additional facts within the claimants knowledge having a direct bearing upon his possession and *bona fide* which he may desire to submit in support of his claim.

68. There should likewise be filed a certificate, under seal of the court having jurisdiction of mining cases within the judicial district embracing the claim, that no suit or action of any character whatever involving the right of possession to any portion of the claim applied for is pending, and that there has been no litigation before said court affecting the title to said claim or any part thereof for a period equal to the time fixed by the statute of limitations for mining-claims in the state or territory as aforesaid, other than that which has been finally decided in favor of the claimant.

69. The claimant should support his narrative of facts relative to his possession, occupancy, and improvements by corroborative testimony of any disinterested person or persons of credibility who may be cognizant of the facts in the case and are capable of testifying understandingly in the premises.

70. It will be to the advantage of claimants to make their proofs as full and complete as practicable.

MILL-SITES.

71. Section 2337 provides that, "where non mineral land not contiguous to the vein or lode is used or occupied by the proprietor of such vein or lode for mining or milling purposes, such non-adjacent surface ground may be embraced and included in an application for a patent for such vein or lode, and the same may be patented therewith, subject to the same preliminary requirements as to survey and notice as are applicable to veins or lodes; but no location hereafter made of such non-adjacent land shall exceed five acres, and payment for the same must be made at the same rate as fixed by this chapter for the superfices of the lode. The owner of a quartz-mill or reduction-works, not owning a mine in connection therewith, may also receive a patent for his mill-site, as provided in this section."

72. To avail themselves of this provision of law, parties holding the possessory right to a vein or lode, and to a piece of non-mineral land not contiguous thereto, for mining or milling purposes, not exceeding the quantity allowed for such purpose by section 2337 United States revised statutes, or prior laws, under which the land was appropriated, the proprietor of such vein or lode may file in the proper land-office their application for a patent, under oath, in manner already set forth herein, which application, together with the plat and field-notes, may include, embrace and describe, in addition to the vein or lode, such non-contiguous mill-site, and after due proceedings as to notice, etc., a patent will be issued conveying the same as one claim.

73. In making the survey in a case of this kind, the lode-claim should be described in the plat and field-notes as "Lot No. 37, B," or whatever may be its appropriate numerical designation; the course and distance from a corner of the mill-site to a corner of the lode claim to be invariably given in such plat and field-notes, and a copy of the plat and notice of application for patent must be conspicuously posted upon the mill-site, as well as upon the vein or lode for the statutory period of sixty days. In making the entry no separate receipt or certificate need be used for the mill-site, but the whole

area of both lode and mill-site will be embraced in one entry, the price being five dollars for each acre and fractional part of an acre embraced by such lode and mill-site claim.

74. In case the owner of a quartz-mill or reduction-works is not the owner or claimant of a vein or lode, the law permits him to make application therefor in the same manner prescribed herein for mining-claims, and after due notice and proceedings, in the absence of a valid adverse filing, to enter and receive a patent for his mill-site at said price per acre.

75. In every case there must be satisfactory proof that the land claimed as a mill-site is not mineral in character, which proof may, where the matter is unquestioned, consist of the sworn statement of the claimant, supported by that of one or more disinterested persons capable from acquaintance with the land to testify understandingly.

76. The law expressly limits mill-site locations made from and after passage to *five acres*.

77. The register and receiver will preserve an unbroken consecutive series of numbers for all mineral entries.

PROOF OF CITIZENSHIP.

78. The proof necessary to establish the citizenship of applicants for mining patents must be made in the following manner: In case of an incorporated company, a certified copy of their charter or certificate of corporation must be filed. In case of an association of persons unincorporated, the affidavit of their duly authorized agent, made upon his own knowledge, or upon information and belief, setting forth the residence of each person forming such association, must be submitted. This affidavit must be accompanied by a power of attorney from the parties forming such association, authorizing the person who makes the affidavit of citizenship to act for them in the matter of their application for patent.

79. In case of an individual or an association of individuals who do not appear by their duly authorized agent, you will require the affidavit of each applicant, showing whether he is a native or naturalized citizen, when and where born, and his residence.

80. In case an applicant has declared his intention to become a citizen, or has been naturalized, his affidavit must show the date, place, and the court before which he declared his intention, or from which his certificate of citizenship issued, and present residence.

81. The affidavit of citizenship may be taken before the register and receiver, or any other officer authorized to administer oaths within the district.

DEPUTY SURVEYORS OF MINING-CLAIMS—CHARGES FOR SURVEYS AND PUBICATIONS—FEES OF REGISTERS AND RECEIVERS.

82. Section 2334 provides for the appointment of surveyors of mineral claims, authorizes the commissioner of the general land-office to establish the rates to be charged for surveys and for newspaper publications, prescribes the fees allowed the local officers for receiving and acting upon applications for mining patents, and for adverse claims thereto, etc.

83. The surveyors general of the several districts will, in pursuance of said law, appoint in each land district as many *competent* deputies for the survey of mining-claims as may seek such appointment; it being distinctly understood that all expenses of these notices and surveys are to be borne by the mining-claimants and not by the United States; the system of making *deposits* for mineral surveys, as required by previous instructions, being hereby revoked as regards *field-work;* the claimant having the option of employing *any* deputy surveyor within such district to do his work in the field.

84. With regard to the *platting* of the claim and other *office-work* in the surveyor-general's office, that officer will make an estimate of the cost thereof, which amount the claimant will deposit with any assistant United States treasurer, or designated depository, in favor of the United States treasurer, to be passed to the credit of the fund created by "individual depositors for surveys of the public lands," and file with the surveyor-general duplicate certificates of such deposit in the usual manner.

85. The surveyors general will endeavor to appoint mineral deputy surveyors, so that one or more may be located in each mining district for the greater convenience of miners.

86. The usual oaths will be required by these deputies and their assistants to the correctness of each survey executed by them.

87. The law requires that each applicant shall file with the register and receiver a sworn statement of all charges and fees paid by him for publication of notice and for survey; together with all fees and money paid the register and receiver, which sworn statement is required to be transmitted to this office, for the information of the commissioner.

88. Should it appear that excessive or exhorbitant charges have been made by any surveyor or any publisher, prompt action will be taken with the view of correcting the abuse.

89. The fees payable to the register and receiver for filing and acting upon applications for mineral-land patents are five dollars to each officer, to be paid by the applicant for patent at the time of filing, and the like sum of five dollars is payable to each officer by an adverse claimant at the time of filing his adverse claim.

90. All fees or charges under this law may be paid in United States currency.

91. The register and receiver will, at the close of each month, forward to this office an abstract of mining applications filed, and a register of receipts, accompanied with an abstract of mineral lands sold, and an abstract of adverse claims filed.

92. The fees and purchase-money received by registers and receivers must be placed to the credit of the United States in the receiver's monthly and and quarterly account, charging up in the disbursing account the sum to which the register and receiver may be respectively entitled as fees and commissions, with limitations in regard to the legal maximum.

HOW TO ESTABLISH THE CHARACTER OF LANDS.

93. Section 2335 provides that all affidavits required under this chapter may be verified before *any* officer authorized to administer oaths within the land-district where the claims may be situated, and all testimony and proofs may be taken before any such officer, and when duly certified by the officer taking the same shall have the same force and effect as if taken before the register and receiver of the land-office.

94. Hearings of this character, as practically distinguished, are of two kinds.

1st. Where lands which are sought to be entered and patented as agricultural are alleged by affidavit to be mineral, or when sought as mineral their non-mineral character is alleged.

The proceedings relative to this class are in the nature of a contest between two or more known parties, and the testimony may be taken on personal notice of at least ten days, duly served on all parties, or, if they cannot be found, then by publication, for thirty days in a newspaper of general circulation, to be designated by the register of the land-office as published nearest to the land in controversy. If publication is made in a weekly newspaper the notice must be inserted in five consecutive weekly issues thereof.

2d. When lands are returned as mineral by the surveyor-general, or are withdrawn as mineral by direction of this office.

When such lands are sought to be entered as agricultural, notice must be given by publication for thirty days, as aforesaid, and also by posting in a conspicuous place on each forty-acre subdivision of the land claimed, for the same period.

95. All notices must describe the land, give the name and address of the claimant, the character of his claim, and the time, place and purpose of the hearing.

Proof of service of notice, when personal, must consist of either acknowledgment or service indorsed on the citation, (which is always desirable,) or the affidavit of the party serving the same, giving date, place, and manner of service; indorsed as aforesaid.

Proof of publication must be the affidavit of the publisher of the newspaper, stating the period of publication, giving dates, stating whether in a daily or weekly issue, and a copy of the notice so published must be attached to, and form a part of the affidavit.

Proof of posting on the claim must be made by the affidavits of two or more persons who state when and where the notice was posted; that it remained so posted during the prescribed period, giving dates, and a copy of the notice so posted must be attached to, and form a part of the affidavits.

Proof of notice is indispensable to the regularity of proceedings, and must accompany the record in every case.

The expense of notice must in every case be paid by the parties thereto.

96. At the hearing there must be filed the affidavit of the publisher of the paper that the said notice was published for the required time, stating when and for how long such publication was made, a printed copy thereof to be attached and made a part of the affidavit. In every case, where practicable, in addition to the foregoing, *personal* notice must be served upon the mineral affiants, and upon any parties who may be mining upon or claiming the land.

97. At the hearing the claimants and witnesses will be thoroughly examined with regard to the character of the land; whether the same has been thoroughly prospected; whether or not there exists within the tract or tracts claimed any lode or vein of quartz or other rock in place, bearing gold, silver, cinnabar, lead, tin, or copper, or other valuable deposit, which has ever been claimed, located, recorded or worked, whether such work is entirely abandoned, or whether occasionally resumed; if such lode does exist, by whom claimed, under what designation, and in which subdivision of the land it lies; whether any placer mine or mines exist upon the land; if so, what is the character thereof—whether of the shallow surface description, or of the deep cement, blue lead, or gravel deposits; to what extent mining is carried on when water can be obtained, and what the facilities are for obtaining water for mining purposes; upon what particular ten-acre sub-divisions mining has been done, and at what time the land was abandoned for mining purposes, if abandoned at all.

98. The testimony should also show the agricultural capacities of the land, what kind of crops are raised thereon, and the value thereof; the number of acres actually cultivated for crops of cereals or vegetables, and within which particular ten-acre subdivisions such crops are raised; also which of these subdivisions embrace his improvements, giving in detail the extent and value of his improvements, such as house, barn, vineyard, orchard, fencing, etc.

99 It is thought that *bona fide* settlers upon lands really agricultural will be able to show, by a clear, logical, and succinct chain of evidence that their claims are founded upon law and justice; while parties who have made little or no permanent agricultural improvements, and who only seek title for speculative purposes, on account of the mineral deposits known to themselves to be contained in the land, will be defeated in their intentions.

100. The testimony should be as full and complete as possible; and, in addition to the leading points indicated above, everything of importance bearing upon the question of the character of the land should be elicited at the hearing.

101. Where the testimony is taken before an officer who does not use a seal, otner than the register and receiver, the official character of such officer must be attested by a clerk of a court of record, and the testimony transmitted to the register and receiver, who will thereupon examine and forward the same to this office, with their joint opinion as to the character of the land as shown by the testimony.

102. When the case comes before this office, such an award of the land will be made as the law and the facts may justify; and in cases where a survey is necessary to set apart the mineral from the agricultural land in any forty-acre tract, the necessary instructions will be issued to enable the agricultural claimant, *at his own expense*, to have the work done, at his option, either by United States deputy, county, or other local surveyor; the survey in such case may be executed in such manner as will segregate the portion of land actually containg the mine, and used as surface-ground for the convenient working thereof, from the remainder of the tract, which remainder will be patented to the agriculturist to whom the same may have been awarded, subject, however, to the condition that the land may be entered upon by the proprietor of of any vein or lode for which a patent has been issued by the United States for the purpose of extracting and removing the ore from the same, where found to penetrate or intersect the land so patented as agricultural, as stipulated by the mining act.

103. Such survey when executed must be properly sworn to by the surveyor, either before a notary public, officer of a court record, or before the register or receiver, the deponent's character and credibility to be properly certified to by the officer administering the oath.

104. Upon the filing of the plat and field-notes of such survey, duly sworn to as aforesaid, you will transmit the same to the surveyor-general for his verification and approval; who, if he finds the work correctly performed, will properly mark out the same upon the original township plat in his office, and furnish authenticated copies of such plat and description both to the proper local land office and to this office, to be affixed to the duplicate and triplicate township plats respectively.

105. In a cases where a portion of a forty-acre tract is awarded to an agricultural claimant and he causes the segregation thereof for the mineral portion, as aforesaid, such agricultural portion will not give a numerical

designation as in the case of surveyed mineral claims; but will simply described as the "Fractional —— quarter of the —— quarter of section ——, in township ——, of range ——, meridian, containing —— acres, the same being exclusive of the land adjudged to be mineral in said forty-acre tract."

106. The surveyor must correctly compute the area of such agricultural portion, which computation will be verified by the surveyor-general.

107. After the authenticated plat and field-notes of the survey have been received from the surveyor-general, this office will issue the necessary order for the entry of the land, and in issuing the receiver's receipt and the register's patent certificate you will invariably be governed by the description of the land given in the order from this office.

108. The fees for taking testimony and reducing the same to writing in these cases will have to be defrayed by the parties in interest. Where such testimony is taken before any other officer than the register and receiver, the register and receiver will be entitled to no fees.

109. If upon a review of the testimony at this office, a ten-acre tract should be found to be properly mineral in character, that fact will be no bar to the execution of the settler's legal right to the remaining *non-mineral* portion of his claim, if contiguous.

110. No fear need be entertained that miners will be permitted to make entries of tracts ostensibly as mining-claims, which are not mineral, simply for the purpose of obtaining possession and defrauding the settlers out of their valuable agricultural improvements; it being almost an impossibility for such a fraud to be consummated under the laws and regulations applicable to obtaining patent for mining-claims.

111. The fact that a certain tract of land is decided upon testimony to be mineral in character is by no means equivalent to an award of the land to a miner. A miner is compelled by law to give sixty days' publication of notice, and posting of diagrams and notices, as a preliminary step; and then, before he can enter the land, he must show that the land yields mineral; that he is entitled to the possessory right thereto in virtue of compliance with local customs or rules of miners or by virtue of the statute of limitations; that he or his grantors have expended, in actual labor and improvements an amount of not less than five hundred dollars thereon, and that the claim is one in regard to which there is no controversy or opposing claim. After all these proofs are met, he is entitled to have a survey made at his own cost where a survey is required, after which he can enter and pay for the land embraced by his claim.

MINING LAWS OF COLORADO.

EXTENT OF LODE CLAIM.

SECTION 1. The length of any lode-claim hereafter located may equal but not exceed fifteen hundred feet along the vein.

SIZE OF CLAIM.

SEC. 2. The width of lode claims hereafter located in Gilpin, Clear Creek, Boulder and Summit counties, shall be seventy-five feet on each side of the center of the vein or crevice; and in all other counties the width of the same shall be one hundred and fifty feet on each side of the centre of the vein or crevice: *Provided*, That hereafter any county may, at any general election, determine on a greater width, not exceeding three hundred feet on each side of the centre of the vein or lode, by a majority of the legal votes cast at said election; and any county, by such vote at such election, may determine upon a less width than above specified.

MANNER OF LOCATING.

SEC. 3. The discoverer of a lode shall, within three months from the date of discovery, record his claim in the office of the recorder of the county in which such lode is situated by a location certificate, which shall contain: 1st, the name of the lode; 2d, the name of the locator; 3d, the date of location; 4th, the number of feet in length claimed on each side of the centre of the discovery shaft; 5th the general course of the lode as near as may be.

WHEN DECLARED VOID.

SEC. 4. Any location certificate of a lode claim which shall not contain the name of the lode, the name of the locator, the date of location, the number of lineal feet claimed on each side of the discovery shaft, the general course of the lode, and such description as shall identify the claim with reasonable certainty, shall be void.

DEPTH OF DISCOVERY SHAFT.

SEC. 5. Before filing such location certificate the discoverer shall locate his claim by first sinking a discovery shaft upon the lode to the depth of at least ten feet from the lowest part of the rim of such shaft at the surface, or deeper, if necessary, to show a well-defined crevice. *Second*, by posting at the point of discovery on the surface, a plain sign or notice containing the name of the lode, the name of the locator, and the date of discovery. *Third*, by marking the surface boundaries of the claim.

MANNER OF STAKING.

SEC. 6. Such surface boundaries shall be marked by six substantial posts, hewed or marked on the side or sides which are in toward the claim, and sunk in the ground, to-wit: One at each corner and one at each centre of each side line. Where it is practically impossible on account of bed-rock or precipitous ground to sink such posts, they may be placed in a pile of stones.

OPEN OR CROSS CUT, AND TUNNEL.

SEC. 7. Any open cut, cross cut or tunnel which shall cut a lode at a depth of ten feet below the surface, shall hold such lode the same as if a discovery shaft were sunk thereon, or an adit of at least ten feet along the lode, from the point where the lode may be in any manner discovered, shall be equivalent to a discovery shaft.

EXTENT OF TIME ALLOWED FOR SINKING DISCOVERY SHAFT.

SEC. 8. The discoverer shall have sixty days from the time of uncovering or disclosing a lode to sink a discovery shaft thereon.

LOCATION CERTIFICATE.

SEC. 9. The location or location certificate of any lode claim shall be construed to include all surface ground within the surface lines thereof and all lodes and ledges throughout their entire depth, the top or apex of which lies inside of such lines extended downward, vertically, with such parts of all lodes or ledges as continue to dip beyond the side lines of the claim, but shall not include any portion of such lodes or ledges beyond the end lines of the claim, or at the end lines continued, whether by dip or otherwise or beyond the side lines in any other manner than by the dip of the lode.

CANNOT BE FOLLOWED.

SEC. 10. If the top or apex of a lode in its longitudinal course extends beyond the exterior lines of the claim at any point on the surface, or as extended vertically downward, such lode may not be followed in its longitudinal course beyond the point where it is intersected by the exterior lines.

RIGHT OF WAY AND TO SURFACE.

SEC. 11. All mining claims now located, or which may hereafter be located, shall be subject to the right of way of any ditch or flume for mining purposes, or any tramway or packtrail, whether now in use, or which may be hereafter laid out across any such location: *Provided, always*, That such right of way shall not be exercised against any location duly made and recorded and not abandoned prior to the establishment of the ditch or flume, tramway, or pack-trail, without consent of the owner, except by condemnation, as in case of land taken for public highways. Parole consent to the location of any such easement, accompanied by the completion of the same over the claim, shall be sufficient without writings. *And provided further*, That such ditch or flume shall be so constructed that the water from such ditch or flume shall not injure vested rights by flooding or otherwise.

SEC. 12. When the right to mine is in any case separate from the ownership or right of occupancy to the surface, the owner or rightful occupant of the surface may demand satisfactory security from the miner, and if it be refused may enjoin such miner from working until such security is given. The order for injunction shall fix the amount of the bond.

RELOCATION OF CLAIMS.

SEC 13. If at any time the locator of any mining claim heretofore or hereafter located, or his assigns, shall apprehend that his original certificate was defective, erroneous, or that the requirements of the law had not been complied with before filing; or shall be desirous of changing his surface boundaries; or of taking in any part of an overlapping claim which has been abandoned; or in case the original certificate was made prior to the passage of this law, and he shall be desirous of securing the benefits of this act, such locator or his assigns may file an additional certificate, subject to the provisions of this act: *Provided*, That such relocation does not interfere with the existing rights of others, at the time of such relocation; and no such relocation, or the record thereof, shall preclude the claiment or claimants from proving any such title or titles as he or they may have held under previous location.

PROOF OF WORK DONE.

SEC. 14. The amount of work done, or improvements made during each year, shall be that prescribed by the laws of the United States.

FORM OF AFFIDAVIT.

SEC. 15. Within six months after any set time, or annual period herein allowed for the performance of labor or making any improvements upon any lode claim, the person on whose behalf such outlay was made, or some person for him, shall make and record an affidavit in substance as follows:

STATE OF COLORADO, }
} ss.
COUNTY OF..... }

Before me, the subscriber, personally appeared.....who, being duly sworn, saith that at least.....dollars' worth of work or improvements were performed or made upon [here describe the claim or part of claim] situate in.....mining district, county of.....State of Colorado. Such expenditure was made by or at the expense of.....owners of said claim, for the purpose of said claim.

[Jurat.] .....(Signature.)

And such signature shall be *prima facie* evidence of the performance of such labor.

OLD CLAIMS REWORKED.

SEC. 16. The relocation of abandoned lode claims shall be by sinking a new discovery shaft and fixing new boundaries in the same manner as if it were the location of a new claim; or the relocator may sink the original discovery shaft ten feet deeper than it was at the time of abandonment, and erect new or adopt the old boundaries, renewing the posts if removed or destroyed. In either case a new location stake shall be erected. In any case, whether the whole or part of an abandoned claim is taken, the location certificate may state that the whole or any part of the new location is located as abandoned property.

RECORD OF CLAIM.

SEC. 17. No location certificate shall claim more than one location, whether the location be made by one or several locators. And if it purports to claim more than one location, it shall be absolutely void, except as to the first lo-

cation therein described. And if they are described together, so that it cannot be told which location is first described, the certificate shall be void as to all.

SEC. 18. All acts or parts of acts in conflict with this act are hereby repealed.

SUPPLEMENTARY ACT APPROVED FEBRUARY 13, 1874.

JURISDICTION OF AUTHORITIES.

SEC. 1. In all actions pending in any district court of this territory, wherein the title or right of possession to any mining claim shall be in dispute, the said court, or the judge thereof, may, upon application of any of any of the parties to such suit, enter an order for the underground as well as the surface survey of such part of the property in dispute as may be necessary to a just determination of the question involved. Such order shall designate some competent surveyor, not related to any of the parties to such suit, or in anywise interested in the result of the same; and upon the application of the party adverse to such application, the court may also appoint some competent surveyor, to be selected by such adverse applicant, whose duty it shall be to attend upon such survey, and observe the method of making the same; said second surveyor to be at the cost of the party asking therefor. It shall also be lawful in such order to specify the names of witnesses named by either party, not exceeding three on each side, to examine such property, who shall thereupon be allowed to enter into such property and examine the same; said court, or the judge thereof, may also cause the removal of any rock, debris, or other obstacle in any of the drifts or shafts of said property, when such removal is shown to be necessary to a just determination of the questions involved: *Provided, however,*, That no such order shall be made for survey and inspection, except in open court, or in chambers, upon notice of application for such order of at least six days, and not then except by agreement of parties or upon the affidavit of two or more persons that such survey and inspection is necessary to the determination of the suit, which affidavits shall state the facts in such case, and wherein the necessity for survey exists; nor shall such order be made unless it appears that the party asking therefor has been refused the privilege of survey and inspection by the adverse party.

RESTORING POSSESSION.

SEC. 2. The said district court of this state, or any judge thereof, sitting in chancery, shall have in addition to the power already possessed, power to issue writs of injunction for affirmative relief, having the force and effect of a writ of restitution, restoring any person or persons to the possession of any mining property from which he or they may have been ousted, by force and violence, or by fraud, or from which they are kept out of possession by threats, or whenever such possession was taken from him or them by entry of the adverse party on Sunday or a legal holiday, or while the party in possession was temporarily absent therefrom. The granting of such writ to extend only to the right or possession under the facts of the case in respect to the manner in which the possession was obtained, leaving the parties to their legal rights on all other questions as though no such writ had issued.

UNLAWFUL ENTRY.

SEC. 3. In all cases where two or more persons shall associate themselves together for the purpose of obtaining the possession of any lode, gulch or placer claim, then in the actual possession of another, by force and violence,

or threats of violence, or by stealth, and shall proceed to carry out such purpose by making threats against the party or parties in possession, or who shall enter upon such lode or mining claim for the purpose aforesaid, or who shall enter upon or into any lode, gulch, placer claim, quartz mill, or other mining property, or not being upon such property, but within hearing of the same, shall make any threats, or make use of any language, signs or gestures, calculated to intimidate any person or persons at work on said property, from continuing to work thereon or therein, or to intimidate others from engaging to work thereon or therein, every such person so offending shall, on conviction thereof, be fined in a sum not to exceed two hundred and fifty dollars, and be imprisoned in the county jail not less than thirty days nor more than six months; such fine to be discharged either by payment or by confinement in said jail until such fine is discharged at the rate of two dollars and fifty cents ($2.50) per day. On trials under this section, proof of a common purpose of two or more persons to obtain possession of property as aforesaid, or to intimidate laborers as above set forth, accompanied or followed by any of the acts above specified by any of them, shall be sufficient evidence to convict any one committing such acts, although the parties may not be associated together at the time of committing the same.

FORCE OR VIOLENCE.

SEC. 4. If any persons shall associate and agree to enter or attempt to enter by force of numbers, and the terror such numbers are calculated to inspire, or by force and violence, or by threats of violence against any person or persons in the actual possession of any lode, gulch or placer claim, and upon such entry or attempted entry, any person or persons shall be killed, said persons, and all and each of them so entering or attempting to enter, shall be deemed guilty of murder in the first degree, and punished accordingly. Upon the trial of such cases, any person or parties cognizant of such entry, or attempted entry, who shall be present, aiding, assisting, or in anywise encouraging such entry, or attempted entry, shall be deemed a principal in the commission of said offense.

ACT APPROVED MARCH 16, 1877.

DRAINAGE.

1830.—SECTION 1. Whenever contiguous or adjacent mines upon the same or upon separate lodes have a common ingress of water, or from subterraneous communication of the water have a common drainage, it shall be the duty of the owners, lessees of occupants of each mine so related to provide for their proportionate share of the drainage thereof.

PENALTY FOR FAILING.

1831.—SEC. 2. Any parties so related failing to provide as aforesaid for the drainage of the mines owned or occupied by them, thereby imposing an unjust burden upon neighboring mines, whether owned or occupied by them, shall pay respectively to those performing the work of drainage their proportion of the actual and necessary cost of expense of doing such drainoge, to be recovered by an action in any court of competent jurisdiction.

MUTUAL INTERESTS.

1832.—SEC. 3. It shall be lawful for all mining corporations or companies, and all individuals engaged in mining, who have thus a common interest in draining such mines, to unite for the purpose of effecting the same, under

such common name and upon such terms and conditions as may be agreed upon; and every such association having filed a certificate of incorporation, as provided by law, shall be deemed a corporation, with all the rights, incidents and liabilities of a body corporate, so far as the same may be applicable.

RIGHT OF ACTION.

1833.—SEC. 4. Failing to mutually agree, as indicated in the preceeding section for drainage, jointly, one or more of the said parties may undertake the work of drainage, after giving reasonable notice; and should the remaining parties then fail, neglect or refuse to unite in equitable arrangements for doing the work, or sharing the expense thereof, they shall be subject to an action therefor as already specified, to be enforced in any court of competent jurisdiction.

HOW TO RECOVER.

1834.—SEC. 5. When action is commenced to recover the cost and expenses for draining a lode or mine, it shall be lawful for the plaintiff to apply to the court, if in session, or to the judge thereof in vacation, for an order to inspect and examine the lodes or mines claimed to have been drained by the plaintiff; or some one for him shall make affidavit that such inspection or examination is necessary for a proper preparation of the case for trial; and the court or judge shall grant an order for the underground inspection and examination of the lode or mines described in the petition. Such order shall designate the number of persons, not exceeding three, besides the plaintiff or his representative, to examine and inspect such lode and mines, and take the measurements thereof, relating te the amount of water drained from the lode or mine, or the number of fathoms of ground mined and worked out of the lode mines claimed to have been drained, the cost of such examination and inspection to be borne by the party applying therefor. The court or judge shall have power to cause the removal of any rock, debris, or other obstacles in any lode or vein, when such removal is shown to be necessary to a just detemination of the question involved: *Provided*, That no such order for inspection and examination shall be made, except in open court or at chambers, upon notice of application for such order of at least three days, and not then except by agreement of parties, nor unless it appears that the plaintiff has been refused the privilege of making the inspection and examination by the defendant or defendants, his or their agent.

WATER RIGHTS.

1835.—SEC. 6. That hereafter, when any person or persons, or corporation, shall be engaged in mining or milling, and in the prosecution of such business shall hoist or raise water from mines or natural channels, and the same shall flow away from the premises of such persons or corporations to any natural channel or gulch, the same shall be considered beyond the control of the parties so hoisting or raising the same, and may be taken and used by other parties the same as that of natural water-courses.

1836.—SEC. 7. After any such water shall have been so raised, and the same shall have so flown into any such natural channel, gulch or draw, the party so hoisting or raising the same shall only be liable for injury caused thereby, in the same manner as riparian owners along natural water-courses.

EXPLANATORY.

1837.—SEC. 8. The provision of this act shall not be construed to apply to incipient or undeveloped mines, but to those only which shall have been opened, and shall clearly derive a benefit from being drained.

EVIDENCE.

1838.—SEC. 9. In trial of cases arising under this act the court shall admit evidence of the normal stand or position of the water while at rest in an idle mine, also the observed prevalence of a common water-level or a standing water-line in the same or separate lodes; also the effect, if any, the elevating or depressing the water by natural or mechanical means in any given lode has upon elevating or depressing the water in the same, contiguous or separate lodes or mines; also the effect which draining or ceasing to drain any given lode or mine had upon the water in the same or contiguous or separate lodes or mines, and all other evidence which tends to prove the common ingress or subterraneous communication of water into the same lode or mine, or contiguous or separate lodes or mines.

NOTE.—By permission of J. W. Morse, Esq., General Passenger Agent of the Union Pacific Railway, we have used the Company's compilation of the Laws of U. S., Land Office Rules and Laws of Colorado.

MINING LAWS OF ARIZONA.

3109—SECTION 1. All persons in the military service of the United States or this territory shall be allowed to locate claims on mineral lodes or veins in the limits of this territory, subject to the requirements of the mining laws of this territory, and shall be protected in the possession of the same, and shall have the same rights in all respects in regard to such claims, as like persons not in the military service.

3110.—SEC. 2. All the laws of any mining district contrary to the spirit and provisions of this act are declared to be null and void, and shall not be evidence in any court having jurisdiction of mining suits in this territory.

3113.—SECTION 1. The mining districts heretofore created in the several counties of this territory are hereby authorized and empowered to make all necessary rules and regulations for the location, registry and working of mines therein; *Provided*, That all locations and registrations of mines and mineral deposits hereafter made in any of the said districts shall be transmitted to the county recorder for record within sixty days after the same shall have been located.

3114. SEC. 2. The county recorders of the several counties are authorized and required to procure suitable books in which the records of all mines and mineral deposits shall be kept, which said books shall be paid for out of the county treasury, and they shall receive for their services herein the following fees: For recording and indexing each claim not exceeding one folio, one dollar; and for each additional folio, twenty cents.

3115.—SEC. 3. Nothing in this act shall be so construed as to affect the claims to mines and mineral deposits heretofore located and duly recorded.

3116.—SEC. 4. The claim of the territory to all mining claims heretofore located is hereby abandoned, and the same hereby declared open to relocation and registry; *Provided*, That nothing herein contained shall be so construed as to affect mining claims heretofore sold and disposed of by the territory.

3117—SEC. 5. Nothing in this act shall be construed to apply to placer mines or mining, or other mineral deposits other than those commonly called veins or lode mines.

3118—SEC. 6. Chapter fifty, of the Howell code, entitled, "Of the registration and government of mines and mineral deposits," as well as all other acts or parts of acts in conflict with the provisions of this act, are hereby repealed.

3119.—SECTION 1. Whenever any one or more joint owners or tenants in common of gold, silver, copper or mineral-bearing ledges or claims may desire to work or develop such ledges or claims, and any other owner or

owners thereof shall fail or refuse to join in said work, after due notice of at least thirty days, given by publication in one newspaper printed in the county in which such ledges or claims are located, and if none be printed in said county, then in any newspaper printed in the territory, said notice to have publication in four successive weeks of said paper, said other owner or owners may, upon application to the district court of the district wherein the ledge or claim is situated, cause the interests of said parties so refusing to be set off or segregated as hereinafter set forth.

3120.—SEC. 2. The owner or owners of any mineral-bearing ledge or claim after the expiration of said thirty days' notice having been given, may, if the party or parties notified fail or refuse to join in the working or developing said ledge or claim may be situated, for a partition or segregation of the interest or interests of the party or parties so failing or refusing to join.

3121.—SEC. 3. The party or parties so applying shall set forth the fact that the said parties have been duly notified, in accordance with section one of this act, and that said party or parties have failed or refused to join in said work; all of which shall be sustained by the oath or affirmation of one or more of the parties applying; and, upon such application being made, the clerk of the said court shall post a notice at the office of the county recorder, and in two other conspicuous places within the district, stating the application, and notifying the parties interested that unless they appear within sixty days and show good cause why the prayer of the petitioner should not be granted, that the same will be granted if good cause can be shown.

3122—SEC. 4. At the expiration of said sixty days, if the party or parties notified do not appear and show good cause why the prayer of the petitioner should not be granted, the court shall appoint two commissioners to go upon the ground and segregate the claims of the parties refusing to join; and in case they do not agree, they to choose a third party and said commissioners shall make a report in writing to said court, who shall issue a decree in conformity with said report, which shall be final, except appeal be taken to the supreme court within thirty days after issuance thereof.

3123 —SEC. 5. The provisions of this act shall not apply to the counties of Yavapia and Pima, and the county of Yuma.

2111.—SECTION 1. No action for the recovery of property in mining claims, or for the recovery or possession thereof, shall be maintained unless it appear that the plaintiff, his ancestor, predecessor, or grantor was seized or possessed of the premises in question within two years before the commencement of the action.

2112.—SEC. 2. No cause of action or defence to an action, founded upon the title to property in mining claims, or to the rents or profits out of the same, shall be effectual unless it appear that the person prosecuting the action or making the defense, or under whose title the action is prosecuted or the defense is made, or the ancestor, predecessor, or grantor of such person, was seized or possessed of the premises in question within two years before the commencement of the act in respect to which such action is prosecuted or defense made.

2113.—SEC. 3. All acts or parts of acts in conflict with this act are hereby repealed.

2366.—SECTION 1. The district courts of said territory shall have exclusive original jurisdiction of all suits and proceedings relating to mines and mineral and auxilary lands, and the registry and denouncement of the same,

and all the jurisdiction, power, and authority conferred upon the probate courts and probate judges by chapter fifty of the Howell code, entitled, "Of the Registry and Government of Mines and Mineral Deposits," or otherwise, are hereby conferred upon the district courts and district judges respectively.

2367.—SEC. 2. That section two of title one of said chapter is hereby repealed, and also all the other provisions of said chapter, conferring jurisdiction upon the probate courts and probate judges, over suits and proceedings relating to mines, mineral, and auxiliary lands, as well as other acts and parts of acts inconsistent with the provisions of this act.

2368.—SEC. 3. All suits and other proceedings in said probate courts, now pending therein, and over which said probate courts have jurisdiction, are hereby transferred to, and shall be continued in, the district court of the county in which said suits and proceedings are now pending.

2669.—SEC 4. The clerks of the probate courts shall, within thirty days after the publication of this act, transfer to and file in the office of the district courts of their respective counties, all records and papers in suits and proceedings relating to mines, mineral and auxiliary lands, which records and papers shall be kept and filed by the clerks of said district courts, and when so transferred and filed, said suits and proceedings shall be proceeded with as though commenced in said district courts; *Provided*, That in counties where there shall be no clerks of the district courts, the records and papers shall be transferred and filed as aforesaid within thirty days after the appointment of said clerks and their acceptance thereof.

3059.—SEC. 623. No action in regard to mining claims shall be maintained berore any justice of the peace.

MINING LAWS OF NEW MEXICO.

LOCATION OF CLAIM AND RECORDING.

SECTION 1. That any person or persons desiring to locate a mining claim upon a vein or lode of quartz or other rock in place bearing gold, silver, cinnabar, lead, tin, copper or other valuable deposit, must distinctly mark the location on the ground so that its boundaries may be readily traced; and post in some conspicuous place on such location, notice in writing stating thereon the name or names of the locator or locators, his or their intention to locate the mining claim, giving a description thereof, by reference to some natural object or permanent monument as will identify the claim; and also within three months after posting such notice, cause to be recorded a copy thereof in the office of the recorder of the county in which the notice is posted; and provided no other record of such notice shall be necessary.

RECORD BOOKS AND FEES.

SEC. 2. In order to cary out the intent of the preceding section, it is hereby made the duty of the probate judges of the several counties of this territory, and they are hereby required to provide at the expense of their respective counties, such book or books as may be necessary and suitable in which to enter the record hereinbefore provided for. The fees for recording such notices shall be ten cents for every one hundred words.

LABOR ON CLAIMS REQUIRED.

SEC. 3. That in estimating the worth of labor required to be performed upon any mining claim, to hold the same by the laws of the United States, in the regulation of mines, the value of a day's labor is hereby fixed at the sum of four dollars; *Provided, however,* That in the sense of this statute, eight hours of labor actually performed upon the mining claim shall constitute a day's labor.

VALIDITY OF PRIOR LOCATIONS.

SEC. 4. All locations heretofore made in good faith, to which there shall be no adverse claim, the certificate of which locations have been or may be filed for record and recorded in the recorder's office of the county where the location is made within six months after the passage of this act, are hereby confirmed and made valid. But where there may appear to be any such adverse claim, the said locations shall be held to be the property of the person having the superior title or claim, according to the laws in force at the time of the making of the said locations.

EJECTMENT.

SEC. 5. An action of ejectment will lie for the recovery of the possession of a mining claim, as well also of any real estate, where the party suing has been wrongfully ousted from the possession thereof, and the possession wrongfully detained.

REPEALING AND SAVING CLAUSE.

SEC. 6. That "an act concerning mining claims, approved January 18th, 1865, and an act amendatory thereof, approved January 3d, 1866; also, an act entitled an act to amend certain acts concerning mining claims in the territory of New Mexico, approved January 1st, 1872, be, and the same are hereby repealed: *Provided*, That no location completed or commenced under said acts shall be invalidated or in anywise affected by such repeal.

SEC. 7. That this act shall take effect and be in full force from and after its passage,

LONG FORM OF LOCATION CERTIFICATE.

STATE OF..... }
COUNTY OF..... } ss.

KNOW ALL MEN BY THESE PRESENTS, That..... of..... , the undersigned, ha..... this ..... day of ....., 188....., located and claimed, and by these presents do..... locate and claim, by right of discovery and location, in compliance with the mining acts of Congress, approved May 10, 1872, and all subsequent acts, and with local customs, laws and regulations, ... linear feet and horizontal measurement on the ..... lode, vein, ledge or deposit, along the vein thereof, with all its dips, angles and variations, as allowed by law, together with ..... feet on each side of the middle of said vein at the surface, so far as can be determined by present developments; and all veins, lodes, ledges, or deposits and surface ground within the lines of said claim ..... feet running ..... from centre of discovery shaft, and ..... feet running ..... from centre of discovery shaft, said discovery shaft being situate upon said lode, vein, ledge or deposit, and within the lines of said claim, in ..... Mining District, County of ..... and State of .....described by metes and bounds as follows, to-wit: Beginning at corner No. 1. .....

.....

Said lode was located on the ..... day of ....., A. D. 188.....

Attest: .....[L. S.]

....[L. S.]

.....[L. S.]

Date of certificate, ... A. D. 188.....

NOTICE OF LOCATION--SHORT FORM. (NEW MEXICO.)

KNOW ALL MEN BY THESE PRESENTS, That the undersigned, having complied with the requirements of chapter six, title xxxii, of the United States, and with the local customs, laws and regulations, has his day .... 188....., discovered and located .....

.....

Attest: Witnesses. .....Locator.

.....

.....

FORM OF A MINING DEED.

THIS INDENTURE, Made this ..... day of ....., in the year of our Lord eighteen hundred and eighty ....., between ....., of the county of ....., and state of ....., of the first part, and ....., of the county of ....., and state of ....., of the second part:

WITNESSETH, That the party of the first part, for and in consideration of the sum of ..... dollars, lawful money of the United States of America, to ..... in hand paid by the said part ..... of the second part, the receipt whereof is hereby acknowledged, ha ..... granted, bargained, sold, remised, released, and forever quit-claimed, and by these presents do grant, bargain, sell, remise, release and forever quit-claim unto the said part ..... of the second part, and to ..... heirs and assigns, the following described property, to-wit: .....

Together with all the dips, spurs and angles, and also all the metals, ores, gold and silver bearing quartz rock, and earth therein; and all the rights, privileges and franchises thereto incident, appendant and appurtenant, or therewith usually had and enjoyed; and also all and singular, the tenements, hereditaments and appurtenances thereto belonging, or in any wise appertaining, and the rents, issues and profits thereof; and also, all the estate, right, title, interest, property, possession, claim and demand whatsoever, as well in law as in equity, of the said part..... of the first part, of, in, or to the said premises, and every part and parcel thereof, with the appurtenances.

TO HAVE AND TO HOLD, all and singular, the said premises, together with the appurtenances and privileges thereto Incident unto the said part..... of the second part, ... heirs and assigns forever.

IN WITNESS WHEREOF, The said part ..... of the first part ha .... hereunto set ..... hand and seal, the day and year first above written.

Signed, sealed and delivered in presence of { ..... [Seal] ..... [Seal] ..... [Seal]

.....

State of .....
County of ..... } ss.

I, ..., in and for said County and State, do hereby certify that ....., personally known to me to be the person, whose name ..... subscribed to the annexed deed, appeared before me this day in person, and acknowledged that ..... signed, sealed and delivered said instrument of writing as ..... free and voluntary act, for the uses and purposes therein set forth. In witness whereof I have set my nand and official seal this ..... day of ..... A. D. 188.....

[Seal.] .....

.....

FORM OF A BOND FOR A DEED.

KNOW ALL MEN BY THESE PRESENTS, That ..... of the county of ....., and state of ..... (or territory of), of the first part, ... held and firmly bound unto ....., of the county of ...., and State of (or territory of), of the second part, in the penal sum of ..... dollars to be paid said second party, ... heirs, executors, administrators or assigns, to which payment, well and truly to be made, the first party do hereby bind ...., heirs, executors and administrstors, and every one of them, jointly and severally, firmly by these presents.

Witness ..... hand and seal this ..... day of ....., in the year of our Lord, one thousand eight hundred and eighty .....

WHEREAS, the above bounden first party ha..... this day sold to the said second party certain real estate situated in (name the district here), county of..... ....., State or territory of ....., to-wit: (*here describe the dimensions of the claim as given in the survey*).

TOGETHER WITH all and singular the lodes and veins within the lines of said claim, and all mines, minerals, dumps, plumb, fixtures, machinery, tramways, easements, improvements, rights, privileges and appurtenances thereto in anywise belonging, for the sum of ..... dollars, to be paid to the first party, ... executors, administrators or assigns, or deposited to ....credit in ....., on or before the ..... day of ....., in the year of our Lord one thousand eight hundred and eighty .....

NOW THEREFORE, The condition of the above obligation is such, that if the above bounden ....., ... heirs or assigns, on payment or deposit of the said sum of ..... dollars, in manner aforesaid, and expressly within the time limited as aforesaid, time being the requisite of this contract, as to such payment or deposit, shall make, execute and acknowledge to said second party a good and sufficient WARRANTY DEED to the said ....., ... his heirs and assigns, or to such person, persons or company as ..... shall nominate, conveying said premises with good and perfect title, free from encumbrance, then this obligation to be void, otherwise to remain in full force and virtue in law.

..... [SEAL.]